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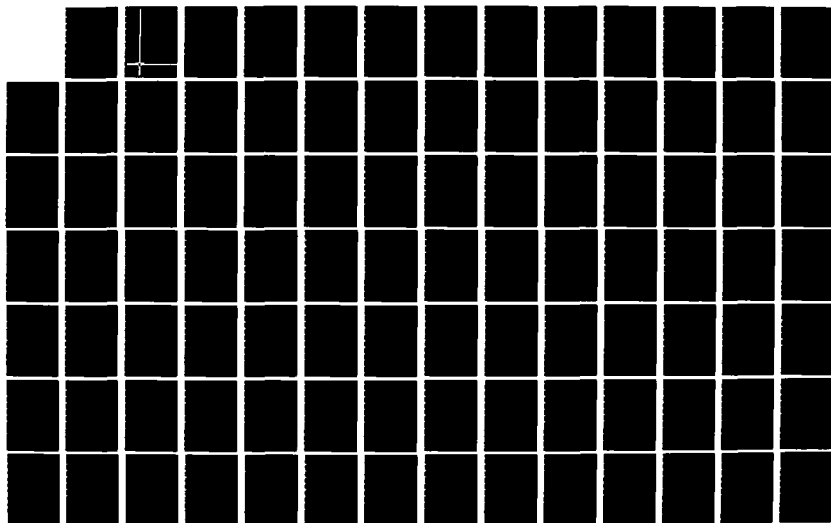
POWER CONDITIONING EQUIPMENT AVAILABILITY SURVEY(U)
ARMY BELVOIR RESEARCH AND DEVELOPMENT CENTER FORT
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Report 2395

POWER CONDITIONING EQUIPMENT AVAILABILITY SURVEY

by
W. David Lee

December 1983

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) -This report presents the results of a survey of the power conditioning market conducted to determine the availability and characteristics of electrical power conditioning equipment, both solid state and rotating. The survey was conducted by means of a questionnaire furnished to prospective sources which were sought through a synopsis in The Commerce Business Daily, direct mail requests and contacts with Belvoir Research and Development Center Foreign Liaison Offices. Summaries of the survey data are presented along with analyses and conclusions regarding capabilities, cost, weight, volume and suitability for the military environment.			

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SUMMARY

A survey of the power conditioning market has been conducted to determine the availability and characteristics of electrical power conditioning equipment, both solid state and rotating. Sources for the survey were sought through synopsis in the Commerce Business Daily as well as direct mail requests and contacts with Belvoir Research and Development Center Foreign Liaison Offices and foreign embassies. The survey was conducted by means of a questionnaire furnished to prospective sources. Data from the survey are summarized in this report. The survey data show that general purpose, multifrequency, multivoltage power conditioners are not presently available. Most single-frequency-in, single-frequency-out combinations of standard voltage and connections are supported, however. Few units are designed for the military environment, and little attention has been devoted to minimizing size and weight.

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POWER CONDITIONING EQUIPMENT

AVAILABILITY SURVEY

I. BACKGROUND

A TRADOC/DARCOM Letter of Agreement (LOA) for a Family of Military Power Conditioners established a requirement and an operational concept for the use of electrical power conditioners by Army field units. This LOA is included as Appendix A of this report. The family of power conditioners as envisioned by the LOA would consist of eight units in ratings from 1.5 kW to 200 kW, coinciding with the ratings of the DOD standard family of Mobile Electric Power Sources. The units would be used to condition power for tactical systems, supply uninterruptible power as required, and to supply general purpose power in semi-fixed locations from sources of incompatible power. They would be capable of voltage and frequency conversion as well as upgrading of power quality. As one step in the definition of a program to provide this capability, Belvoir Research and Development Center has been requested by DOD Project Manager-Mobile Electric Power (PM-MEP) to identify the types and characteristics of power conditioning equipment available on the commercial market for potential procurements as Military-adapted commercial items or as non-development items within the range of ratings stated.

II. OBJECTIVES

This survey of the commercial market has been conducted to determine the availability of power conditioning equipment and to compare characteristics of that equipment with requirements of the LOA. It encompasses all types of power conditioning equipment: converters, inverters, frequency changers, line conditioners and uninterruptible power supplies. Both rotating and solid state equipment are included. The following functional definitions of equipment types are used within this report: (1) *converters* accept a.c. or d.c. input and provide d.c. output; (2) *inverters* accept d.c. input and provide a.c. output; (3) *frequency changers* accept input at one or more a.c. frequencies and provide output at one or more different a.c. frequencies; (4) *line conditioners* accept a.c. input and provide a.c. output at the same frequency with enhanced voltage regulation of the line and transient or noise suppression; (5) *uninterruptible power supplies* (UPS) provide no-break power from a separate a.c. or d.c. energy source during disruption of the primary supply.

III. APPROACH

The survey was undertaken by means of a questionnaire sent to prospective sources. A copy of the questionnaire is included as Appendix B and a copy of the cover letter, as Appendix C. Sources were sought through a synopsis published in the Commerce Business Daily (CBD) on 17 December 1982. A copy of the synopsis is included as Appendix D. In addition to those sources responding to the CBD synopsis, copies of the questionnaire were sent to companies otherwise known to be active in the field. Contacts were also made through the Belvoir Research and Development Center Liaison Offices for possible sources in Australia, Britain, Canada, France and Germany. A list of sources to whom the questionnaire was sent is included as Appendix E.

Responses to the questionnaire were used in assembling this report. In some cases, companies provided brochures or product data sheets in addition to or instead of the questionnaire. In those cases, information was transferred where possible to the questionnaire format for use in analyzing responses. The citation of manufacturers and trade names of commercially available products does not constitute official endorsement or approval of the use of such products. Every effort has been made to report accurately the data furnished. However, no liability is assumed.

The questionnaire solicits information concerning technical performance of the equipment and its availability and cost. A brief summary follows:

Section 1 asks for the manufacturer's name.

Section 2 requests data on the basic configuration of the equipment such as input/output connections, frequency, power, size and weight, and UPS capability.

Section 3 asks for the technology(ies) utilized. It is intended to determine general techniques and components such as the use of SCRs or transistors, step wave inverters, ferroresonant transformers, high frequency switching, etc., rather than proprietary details of the equipment design.

Section 4 requests electrical performance specifications with regard to voltage and frequency regulation and modulation, harmonic distortion, and phase relationships.

Section 5 requests limitation of the equipment with respect to outside effects such as load power factor, short circuit, and fluctuations at the input line.

Section 6 asks for ambient operating conditions including temperature and elevation limits, electromagnetic and nuclear radiation hardness, and protection against an outdoor environment.

Section 7 requests information on operation, reliability and maintainability and requests such data as efficiency, noise level, MTBF, and use of high reliability parts.

Section 8 requests information on controls, instrumentation and protection, and conformance to safety standards.

Section 9 requests cost and production data.

IV. RESULTS

The results of this survey are presented in the form of tables listing selected data for each model of power conditioning equipment reported, as discussed below. A concerted effort has been made to obtain information on all power conditioning equipment currently in production and being marketed.

In the process of gathering the data in this report, 58 U.S. and 17 foreign companies were queried (see Appendix E). Information obtained from the respondents encompasses more than 460 models of power conditioning equipment. The responding companies and the reported items of equipment are considered to be a good representation of the power conditioning field at this time as to the range of cost, size, weight, environmental factors, voltages, frequencies, and electrical performance.

For the purposes of this report, power conditioning equipment has been separated into the following functional categories as defined in Section II: UPS, Frequency Changers, Inverters, Converters, and Line Conditioners. Within these categories, units are grouped by power rating into four ranges: 0 kW to 5 kW, 5 kW to 15 kW, 15 kW to 60 kW, and greater than 60 kW.

V. DATA

Selected data for each model are reported in Tables 1 through 5. The tables present characteristics of the equipment which are considered most important for military applications. In addition to company name and model designation, the characteristics include: input and output voltage, frequency and phase, size and weight, output voltage regulation, frequency regulation and total harmonic distortion, and environmental tolerances. The data shown are as provided by the sources. In cases where data sheets were furnished instead of completed questionnaires, data were extracted from the sheets. Blanks indicate that the data were not provided. Unless otherwise specified, dimensions are in

inches and weight in pounds. In cases where more than one input or output voltage is shown as being available, the word "or" indicates that a selection may be made when specifying the unit; "and" indicates that the combination is furnished on the unit as delivered. Power rating is given in kVA. Most units allow for at least 0.8 power factor, lagging.

1. Line Conditioners (Table 1). Line conditioners are used primarily for transient and electrical noise suppression and for a degree of voltage regulation of input power to sensitive equipment. These functions are accomplished through such techniques as filtering, use of transient energy absorbers (MOVs, Transorbs, etc.), and ferroresonant and step-changing transformers. No control of frequency (or frequency changing) is provided. The models reported are not designed for rough handling or harsh environments.

LINE CONDITIONERS
0 < P ≤ 5kW

Table 1.

Company	Gould	Gould			
Model					
Rating	DLC 306X	DLC 506X			
Input	3.0kVA	5.0kVA			
Output	96-260v (depending on model), 1 phase, 60Hz	96-260v (depending on model), 1 phase, 60Hz			
Size	120 or 120/240v, 60Hz 20 x 16.5 x 13.25H	120 or 120/240v, 60Hz 20 x 16.5 x 13.25H			
Weight	(0.84 ft ³ /kVA) 300 lb	(0.5 ft ³ /kVA) 400 lb			
Voltage Reg	3%	(80 lb/kVA) 3%			
Frequency Regulation					
Harmonic Distortion, Environment	5% (output)	5% (output)			
	0°C to 40°C	0°C to 40°C			

X = number specifying voltage range and connections

LINE CONVERTERS
5 < P ≤ 15kW

Table 1 (Continued).

Company	Gould	Gould	Gould
Model			
Rating	DIC 756X	DIC 1006X	DIC 1506X
Power	7.5kVA	10.0kVA	15kVA
Output	96-260v (depending on model), 60Hz	96-260v (depending on model), 60Hz	208 or 480v 3 phase, 60Hz
Size	120v or 120/240 C.T., 60Hz 21.38 x 35.38 x 32H	120v or 120/240 C.T., 60Hz 21.38 x 35.38 x 32H	120v or 120/240 C.T. or 120/208, 60Hz 28.75 x 24 x 61H
Weight	(1.87 ft ³ /kVA) 600 lb	(1.4 ft ³ /kVA) 950 lb	(1.6 ft ³ /kVA) 1550 lb
Voltage Reg	(80 lb/kVA) 3%	(95 lb/kVA) 3%	(103 lb/kVA) 3%
Frequency Regulation			
Harmonic Distortion	5% (output)	5% (output)	5% (output)
Environment			
	0-40°C	0-40°C	0-40°C

X = number specifying voltage range

2. Inverters (Table 2.). Inverters are used to develop an a.c. output from a d.c. source. (Thus, solid state UPS systems and frequency changers typically include an inverter section.) The inverters reported in this group are configured as stand-alone systems. Included in the group are units designed for aircraft power systems and fuel cell and solar photovoltaic systems. Weight to power ratios are shown in Figure 1.

The aircraft inverter technology appears promising. At the 1-kVA level, Avionic Instruments produces 50-Hz, 60-Hz and 400-Hz models (Nos. 3A1000, 2A1000, and 1B1000, respectively) with weight to power ratios of about 13 lb/kVA. These units are rated for a wide temperature range (-55°C to $+71^{\circ}\text{C}$) and for high altitude (55,000 ft) operation. Voltage and frequency regulation of the 3A1000 model are within the precise power definition of MIL-STD-1332. As manufactured and distributed, each of the Avionic Instruments units provide only single-frequency/single-voltage output. Leland, also, has models with weight to power ratios in the 13 lb/kVA to 17 lb/kVA range at ratings of 1 kVA to 3 kVA which have operating temperature ranges of -55°C to $+71^{\circ}\text{C}$ and altitude to 55,000 ft. Bendix Model 32827-10 is a motor-generator (MG) type inverter with a weight to power ratio of 15 lb/kVA and an operating temperature of -55°C to $+85^{\circ}\text{C}$.

Aerospace Avionics Model SVS 500 (0.5 kVA) has 60-Hz and 400-Hz output but with a narrower temperature range (0°C to 50°C). DECC Model 61098 has a weight to power ratio of 29 lb/kVA with 60-Hz and 400-Hz output. This model was specifically developed for the MERADCOM fuel cell program. The Powertronics unit has variable output frequency but is part of a system and is not available as a separate unit.

INVERTERS
0 < P ≤ 5kW

Table 2.

Company	Aerospace Avionics	Aerospace Avionics	Aerospace Avionics	Aerospace Avionics
Model	SV 100	SV 250	SVS 500	Multiple inverter system
Rating	0.1kVA	.25kVA	0.5kVA	.6kVA .4kVA .1kVA
Input	17-35v DC	9-36v DC	20-28VDC	25-32v DC 25-32v DC 25-44v DC
Output	115VAC 1 phase, 400Hz 4.5 x 7 x 5H (0.91 ft ³ /kVA) 4.7 lb	115VAC 1 phase, 400Hz 9 1/4 x 4 3/4 x 5 1/4H (0.53 ft ³ /kVA) 10 lb	115VAC, 1 phase 60 or 400Hz	120VAC 400Hz 120VAC 60Hz 24VAC 400Hz
Size	18	18	18	16 x 14x 14H
Weight	(47 lb/kVA)	(40 lb/kVA)		
Voltage Reg	1%	1%	1%	2%
Frequency Regulation	1%	0.1%	2%	1%
Harmonic Distortion	5%	3%	3%	3%
Environment		-54 to +85°C 65000 elevation	0-50°C Drip-proof	0-35°C Drip-proof

INVERTERS

0 < P ≤ 5kW

Table 2. (Continued).

Company	Aerospace Avionics	Aerospace Avionics	DECC	DECC
Model				DECC
Rating	SV 1000	1.5kVA inverter	61098	61233
Input	1kVA	1.5kVA	1.5kW	5kW
Output	9-36VDC	205-320VDC	36-70VDC	170-300VDC
Size	115v 1 phase, 400Hz 11 1/2 x 5 1/2 x 8H	120VAC 60Hz	Selectable 120 or 240, 60 or 400Hz 19.5 x 8.5 x 8.5H	115v and 115 or 230v
Weight	(0.29 ft ³ /kVA) 23 lb		(0.43 ft ³ /kVA) 54 lb	
Voltage Reg	1%	2%	(29 lb/kVA) 2%	
Frequency Regulation	0.1%	1%	0.5Hz	
Harmonic Distortion	5%	5%	3% (output)	
Environment	-54 to +85°C 65000 elevation	0-55°C		

Table 2. (Continued).

INVERTERS
 $0 < P \leq 5kW$

Company	Avionic Instruments	Avionic Instruments	Avionic Instruments	Avionic Instruments
Model				
Rating	1A125	2A125	3A125	3A250
Input	.125kVA	.125kVA	.125kVA	.25kVA
Output	20 - 37 VDC	20 - 37 VDC	20 - 37 VDC	20 - 37 VDC
Size	115 VAC, 26 VAC 400Hz	115 VAC, 60Hz	115 VAC, 220 VAC 50Hz	115 VAC, 220 VAC 50Hz
Weight	4.0 lb (32 lb/kVA)	4.0 lb (32 lb/kVA)	4.0 lb (32 lb/kVA)	4.5 lb (18 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	1%	1%	1%	1%
Harmonic Distortion	.5%	.5%	.5%	.5%
Environment	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft

Table 2. (Continued).

INVERTERS
0 < P ≤ 5kW

Company	Avionic Instruments	Avionic Instruments	Avionic Instruments	Avionic Instruments
Model	1B250	2A250	2A1000 - ()	1B1000 - ()
Rating	.25kVA	.25kVA	1kVA	1kVA
Input	20 - 37 VDC	20 - 37 VDC	20 - 37 VDC	20 - 37 VDC
Output	115 VAC, 26 VAC 400Hz	115 VAC, 60Hz	115 VAC, 60Hz	115 VAC, 26 VAC 400Hz
Size	4.5 lb (18 lb/kVA)	4.5 lb (18 lb/kVA)	12 x 8.5 x 4H (0.24 ft ³ /kVA)	12 x 8.5 x 4H (0.24 ft ³ /kVA)
Weight	4.5 lb (18 lb/kVA)	4.5 lb (18 lb/kVA)	12.5 lb (12.5 lb/kVA)	13.5 lb (13.5 lb/kVA)
Voltage Reg	1%	1%	2%	2%
Frequency Regulation	1%	1%	1%	1%
Harmonic Distortion	.5%	.5%	1%	1%
Environment	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft

Table 2. (Continued).

INVERTERS
 $0 < P \leq 5 \text{ kW}$

Company	Avionic Instruments	Avionic Instruments	Elgar Corp	Bendix Corp
Model	1B800 - ()	3A1000 - ()	INV-502	32B27-10 (MG)
Rating	.8kVA	1kVA	5kVA	5kVA
Input	20 - 37 VDC	20 - 37 VDC	105 - 140 VDC	28VDC
Output	115 VAC, 26 VAC 400Hz 12 x 8.5 x 4H	115 VAC, 220 VAC 50Hz 12 x 8.5 x 4H	120 VAC 19 x 37 x 72H	115 or 200VAC 3 phase, 400Hz 20.25 x 7.75 x 11.75H
Size	(0.295 ft ³ /kVA) 13.5 lb	(0.236 ft ³ /kVA) 12.5 lb	(5.86 ft ³ /kVA) 850 lb	(0.213 ft ³ /kVA) 75 lb
Weight	(16.9 lb/kVA)	(12.5 lb/kVA)	(170 lb/kVA)	(15 lb/kVA)
Voltage Reg	2%	1%	2%	
Frequency Regulation	1%	1%	0.25%	
Harmonic Distortion	1%	.5%	5%	
Environment	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft	0 to 40°C	-55 to 85°C

INVERTERS
0 < P ≤ 5kW

Table 2. (Continued).

Company	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics Technology Inc. (J.E.T.)	Jet Electronics Technology Inc. (J.E.T.)
Model	SI 125DA	SI 1500A	SI 1000B	SI 2500B
Rating	1.25 kVA	1.5 kVA	1 kVA	2.5 kVA
Input	24-30v DC	21-36.4v DC	24-30v DC	20-30v DC
Output	115VAC 1 phase, 400Hz 10.5 x 5.43 x 7.69H (0.20 ft ³ /kVA)	115VAC 1 phase, 400Hz 10.5 x 5.43 x 7.69H (0.17 ft ³ /kVA)	115VAC 1 phase, 400Hz 8.27 x 5.56 x 5.07H (0.13 ft ³ /kVA)	115VAC 1 phase, 400Hz 13 x 7.0 x 9.55H (0.20 ft ³ /kVA)
Size	24 lb	23.5 lb	14.6 lb	45 lb
Weight	(19.2 lb/kVA)	(15.7 lb/kVA)	(14.6 lb/kVA)	(18.0 lb/kVA)
Voltage Reg	3%	+3%	3%	+3%
Frequency Regulation	1%	+1%	1%	+1%
Harmonic Distortion	5%	5%	5%	6%
Environment	3%			
	-55 to 85°C 55000 ft @ 30°C	-55 to 85°C 55000 ft @ 25°C	-55 to 71°C 51000 ft @ 20°C	-55 to 71°C 50000 ft

Table 2. (Continued).

INVERTERS
 $0 < P \leq 5 \text{ kW}$

Company	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics and Technology Inc. (J.E.T.)	Elgar Corp	Elgar Corp
Model	SI 3000A	SI 3003		INV-102	INV-252
Rating	3.0 kVA	3.0 kVA		1 kVA	2.5 kVA
Input					
Output	20-36v DC	24-32v DC		105-140VDC	105-140VDC
Size	115VAC 1 phase, 400Hz 13 x 7 x 9.53H	115VAC 3 phase, 400Hz 13 x 7 x 9.5H	120VAC 19 x 19 x 12.25H	120VAC 19 x 19 x 14H	120VAC 19 x 19 x 14H
Weight	(0.167 ft ³ /kVA) 49 lb	(0.167 ft ³ /kVA) 55 lb	(2.56 ft ³ /kVA) 190 lb	(1.17 ft ³ /kVA) 230 lb	(1.17 ft ³ /kVA) 230 lb
Voltage Reg	(16.3 lb/kVA) +3%	(18.3 lb/kVA) +2.5VAC	(190 lb/kVA) 2%	(92 lb/kVA) 2%	(92 lb/kVA) 2%
Frequency Regulation	±1%	±4Hz	0.4%	0.25%	0.25%
harmonic Distortion	6%	5%	5%	5%	5%
Environment					
	-55°C to +71°C 50000 ft	-55°C to 71°C	0 to 40°C	0 to 40°C	0 to 40°C

Table 2. (Continued).

INVERTER
0 < P ≤ 5kW

Company	Flite-Tronics PC 15H	Flite-Tronics PC 16	Flite-Tronics PC 17	Flite-Tronics PC 17A
Model	\$1290 (\$4.30/VA)	\$1295 (\$5.18/VA)	\$1050 (\$3.08/VA)	\$1975 (\$2.63/VA)
Rating	.30kVA	.40kVA	.6kVA	.75kVA
Input	28VDC	28VDC	28VDC	28VDC
Output	26 or 115VAC, 400Hz 10 5/8 x 6 x 3 7/32H	115VAC, 60Hz 12 x 7.5 x 4H	26 or 115VAC, 400Hz 12 x 8 1/2 x 4 1/12H	26 or 115VAC, 400Hz 12 x 8 1/2 x 4 1/16H
Size	(0.396 ft ³ /kVA) 8.1 lb	(0.833 ft ³ /kVA) 15 lb 5 oz	(0.40 ft ³ /kVA) 14 lb	(0.32 ft ³ /kVA) 15.6 lb
Weight	(27 lb/kVA)	(61.2 lb/kVA)	(23.3 lb/kVA)	(20.8 lb/kVA)
Voltage Req				
Frequency Regulation				
Harmonic Distortion	3 to 7%		3 to 7%	3 to 7%
Environment	-65 to 160°F 95%RH 45,000 ft	-10 to 160°F 45,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

INVERTER
0 < P ≤ 5kW

Table 2. (Continued).

Company	Flite-Tronics PC 50	Flite-Tronics PC 125	Flite-Tronics PC 250	Flite-Tronics PC 251
Model	\$695 (\$13.90/VA)	\$875 (\$7.00/VA)	\$1250 (\$5.00/VA)	\$1295 (\$5.18/VA)
Rating	.05kVA	.125kVA	.25kVA	.25kV
Input	20 - 37VDC	20 - 37VDC	20 - 37VDC	18 - 37VDC
Output	26 or 115VAC, 400Hz 7 x 4 9/16 x 2 3/4H	26 or 115VAC, 400Hz 7 x 5.1 x 2.75H	26 or 115VAC, 400Hz 9.39 x 6 x 3.23H	26 or 115VAC, 400Hz 7 x 5 x 2.75H
Size	(1.02 ft ³ /kVA)	(0.455 ft ³ /kVA)	(0.421 ft ³ /kVA)	(0.223 ft ³ /kVA)
Weight	4.3 lb	5.1 lb	8.1 lb	5 lb
Voltage Reg	(86.0 lb/kVA)	(40.8 lb/kVA)	(32.4 lb/kVA)	(20 lb/kVA)
Frequency Adjustment				
Harmonic Distortion	3%	3%	3.5%	4%
Environment	-67 to 160°F 95%RH 50,000 ft	-67 to 160°F 95%RH 50,000 ft	-67 to 160°F 95%RH 50,000 ft	-67 to 160°F 50,000 ft

INVERTER
0 < P ≤ 5kW

Table 2. (Continued).

Company	Flite-Tronics	Flite-Tronics	KGS Electronics	KGS Electronics
Model	PC 350	PC 450		
Rating	\$1425 (\$4.07/VA)	\$1635 (\$3.63/VA)	SPC 5	SPC 10
Input		.45kVA	.05kVA	.10kVA
Output	20 - 37VDC	20 - 37VDC	20 - 36VDC	22 - 32VDC
Size	26 or 115VAC, 400Hz 9.39 x 6 x 4.13H (0.365 ft ³ /kVA)	26 or 115VAC, 400Hz 9.39 x 6 x 4.13H (0.299 ft ³ /kVA)	26 or 115VAC, 400Hz 6.5 x 4.12 x 2.75H (0.852 ft ³ /kVA)	26 or 115VAC, 400Hz 8.25 x 4.5 x 3.55H (0.763 ft ³ /kVA)
Weight	8.75 lb (25 lb/kVA)	9.9 lb (22 lb/kVA)	3 lb (60 lb/kVA)	5.2 lb (52 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	4%	4%	3 to 7%	3 to 7%
Environment	-67 to 160°F 50,000 ft	-67 to 160°F 50,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

Table 2. (Continued).

INVERTER
 $0 < P \leq 5kW$

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPC 30	SPC 38	SPC 60	SPC 60B
Rating	.3kVA	.375kVA	.6kVA	.6kVA
Input	28VDC	20 - 37VDC	22 - 36VDC	22 - 30VDC
Output	26 or 115VAC, 400Hz 10 x 6 x 3 7/32H	26 or 115VAC, 400Hz 10 x 6 x 3 5/8H	26 or 115VAC, 400Hz 11 1/4 x 7 3/4 x 4H	208 or 240VAC, 400Hz 11 1/4 x 7 3/4 x 4H
Size	(0.373 ft ³ /kVA)	(0.336 ft ³ /kVA)	(0.336 ft ³ /kVA)	(0.336 ft ³ /kVA)
Weight	8.1 lb	8.8 lb	14 lb	14 lb
Voltage Reg	(27 lb/kVA)	(23.5 lb/kVA)	(23.3 lb/kVA)	(23.3 lb/kVA)
Frequency Regulation				
Harmonic Distortion	3 to 7%	2 to 5%	< 7%	< 7%
Environment	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 50,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

INVERTER
0 < P ≤ 5kW

Table 2. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPC 75	SPS 205	SPS 206	SPS 305
Rating	.75kVA	.4kVA	.4kVA	.47kVA
Input				
Output	20 to 37VDC	28VDC	28VDC	28VDC
Size	5 or 26 or 115VAC, 400Hz 12 x 8 x 4H	115VAC, 50Hz 12 x 7 1/2 x 4H	115VAC, 60Hz 12 x 7 1/2 x 4H	115VAC, 50Hz 12 x 7 1/2 x 4H
Weight	(0.296 ft ³ /kVA) 14 lb	(1.04 ft ³ /kVA) 15.7 lb	(1.04 ft ³ /kVA) 15.7 lb	(0.772 ft ³ /kVA) 18 lb
Voltage Reg	(15.7 lb/kVA)	(78.5 lb/kVA)	(78.5 lb/kVA)	(66.7 lb/kVA)
Frequency Regulation				
Harmonic Distortion	2 to 5%	< 7%	< 7%	< 7%
Environment	-65 to 160°F 95%RH 50,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 45,000 ft

Table 2. (Continued).

INVERTER
0 < P ≤ 5kw

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPS 306	SPS 306B	SPS 1307	SPS 2052
Rating	.3KVA	.375KVA	1.3KVA	.20KVA
Input	28VDC	28VDC	28VDC	28VDC
Output	115VAC, 60Hz 12 x 7 1/2 x 4H	115VAC, 60Hz 12 x 7 1/2 x 4H	115VAC, 60 to 64Hz 14 x 7 3/4 x 4H	230VAC, 50Hz 12 x 7 1/2 x 4H
Size	(0.694 ft ³ /KVA)	(0.556 ft ³ /KVA)	(0.193 ft ³ /KVA)	(1.04 ft ³ /KVA)
Weight	18 lb	18 lb	24.5 lb	15.7 lb
Voltage Req	(60 lb/KVA)	(48 lb/KVA)	(18.8 lb/KVA)	(78.5 lb/KVA)
Frequency Regulation				
Harmonic Distortion	< 7%		< 7%	< 7%
Environment	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 45,000 ft	-65 to 160°F 55,000 ft	-65 to 160°F 45,000 ft

Table 2. (Continued).

INVERTER
0 < P ≤ 5kW

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model				
Rating	SPS 3052	SPS 3062	SPS 3063	SPS 3163
Input	.27 kVA	.3 kVA	.3 kVA	.3 kVA
Output	28VDC	28VDC	28VDC	28VDC
Size	230VAC, 50Hz 12 x 7 1/2 x 4H	Dual 115VAC, 60Hz 12 x 7 1/2 x 4H	115VAC, 60Hz 12 x 7 1/2 x 4H	115VAC, 60Hz 12 x 7 1/2 x 4H
Weight	(0.772 ft ³ /kVA) 18 lb	(0.694 ft ³ /kVA) 18 lb	(0.694 ft ³ /kVA) 18 lb	(0.694 ft ³ /kVA) 18 lb
Voltage Reg	(66.7 lb/kVA)	(60.0 lb/kVA)	(60.0 lb/kVA)	(60.0 lb/kVA)
Frequency Regulation				
Harmonic Distortion	< 7%	< 7%	< 7%	< 7%
Environment	-65 to 160°F 45,000 ft	-65 to 160°F 45,000 ft	-65 to 160°F 45,000 ft	-65 to 160°F 45,000 ft

INVERTER
0 < P ≤ 5 kW

Table 2. (Continued).

Company	Nova Electric	Bendix Corp	Bendix Corp	Bendix Corp
Model	5K-3/6-XX	32B50-19 (MG)	39B168-1	32B180-2 (MG)
Rating	5 kVA	0.25 kVA	0.5 kVA	0.75 kVA
Input	48 or 120 VDC	28 VDC	28 VDC	28 VDC
Output	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 42H	115 or 200 VAC 3 phase, 400 Hz 9.25 x 4.5 x 6.25H	115 VAC, 1 phase, 400 Hz 14.75 x 7.5 x 6.75H	115 VAC, 3 phase, 400 Hz 11.5 x 5.25 x 7.25H
Size	(1.98 ft ³ /kVA) 410 lb	(0.602 ft ³ /kVA) 11.5 lb	(0.864 ft ³ /kVA) 18.5 lb	(0.338 ft ³ /kVA) 21.5 lb
Weight	(82 lb/kVA)	(46 lb/kVA)	(37 lb/kVA)	(28.7 lb/kVA)
Voltage Reg	1%			
Frequency Regulation	0.15%			
Harmonic Distortion	5%			
Environment	-20 to 50°C	-55 to 85°C	-65 to 71°C	-55 to 85°C 50000 ft

X denotes input voltage

INVERTER
0 < P ≤ 5 kW

Table 2. (Continued).

Company	Leland	Leland	Leland	Leland
Model				
Rating	ASH584-1	ASH671-1	ASH584-2	ASH674-1
Input	0.25 kVA	0.25 kVA	0.3 kVA	0.4 kVA
Output	24 to 32 VDC	20 to 32 VDC	24 to 32 VDC	24 to 32 VDC
Size	26 or 115 VAC 1 phase, 400 Hz 9.25 x 4.75 x 5H (0.509 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz 10.63 x 5.25 x 3.13H (0.404 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz 9.25 x 4.75 x 5H (0.424 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz 10.62 x 6.02 x 3.64H (0.337 ft ³ /kVA)
Weight	7.3 lb (29.2 lb/kVA)	5.6 lb (22.4 lb/kVA)	7.5 lb (25.0 lb/kVA)	7.3 lb (18.2 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	5%	4%	4%	4%
Environment	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft

INVERTER
0 < P ≤ 5 kW

Table 2. (Continued).

Company	Leland	Leland	Leland	Leland
Model				
Rating	ASH564-B-2	ASH564-B-6	ASH664-1	ASH574A2
Input	0.8 kVA	1 kVA	1.5 kVA	2.5 kVA
Output	24 to 32 VDC	24 to 32 VDC	20 to 32 VDC	20 to 32 VDC
Size	26 or 115 VAC 1 phase, 400 Hz 12 x 8.5 x 4H (0.295 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz 12 x 8.5 x 4.06H (0.240 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz 12.5 x 7.52 x 6H (0.218 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz 13.1 x 7.52 x 9.56H (0.218 ft ³ /kVA)
Weight	13.8 lb (17.2 lb/kVA)	14.8 lb (14.8 lb/kVA)	25.5 lb (17.0 lb/kVA)	40.23 lb (16.1 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	4%	4%	5%	5%
Environment	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Ieland	Nova Electric	Nova Electric	Nova Electric
Model				
Rating	ASH574A4	1260XX	12400XX	2560XX
Input	3 kVA	0.125 kVA	0.125 kVA	0.25 kVA
Output	20 to 32 VDC	12 or 24 or 48 or 120 VDC	12 or 24 VDC	12 or 24 or 48 or 120 VDC
Size	26 or 115 VAC 1 phase, 400 Hz 13.1 x 7.52 x 9.56H	115 or 230 VAC 1 phase, 50 or 60 Hz 9.75 x 6.5 x 5.25H	115 or 230 VAC 1 phase, 400 Hz 9.75 x 6.5 x 5.25H	115 or 230 VAC 1 phase, 50 or 60 Hz 13.25 x 9 x 6.875H
Weight	(0.182 ft ³ /kVA) 40.75 lb	(1.54 ft ³ /kVA) 19 lb	(1.54 ft ³ /kVA) 14 lb	(1.90 ft ³ /kVA) 37 lb
Voltage Reg	(13.6 lb/kVA)	(152 lb/kVA)	(112 lb/kVA)	(148 lb/kVA)
Frequency Regulation		0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment	-55 to 71°C 55000 ft X denotes input voltage	-20 to 50°C	-20 to 50°C	-20 to 50°C

INVERTER
0 < P ≤ 5 kW

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model	25400XX	5060XX	50400XX	1K6012
Rating	0.25 kVA	0.5 kVA	0.5 kVA	1 kVA
Input	12 or 24 VDC	12 or 24 or 48 or 120 VDC	12 or 24 VDC	12 VDC
Output	115 or 230 VAC 1 phase, 400 Hz 13.25 x 9 x 6.875H	115 or 230 VAC 1 phase, 50 or 60 Hz 14.25 x 11.25 x 6.875H	115 or 230 VAC 1 phase, 400 Hz 14.5 x 11.25 x 6.875H	115 or 230 VAC 1 phase, 50 or 60 Hz 17 x 17 x 8.675H
Size	(1.90 ft ³ /kVA) 25 lb	(1.28 ft ³ /kVA) 60 lb	(1.30 ft ³ /kVA) 45 lb	(1.44 ft ³ /kVA) 125 lb
Weight	(100 lb/kVA)	(120 lb/kVA)	(90 lb/kVA)	(125 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
0 < P ≤ 5 kW

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model	1K60XX	1K400XX	2K60XX	2K400XX
Rating	1 kVA	1 kVA	2 kVA	2 kVA
Input	24 or 48 or 120 VDC	12 or 24 VDC	24 or 48 or 120 VDC	24 VDC
Output	115 or 230 VAC 1 phase, 50 or 60 Hz 16 x 13.75 x 8.75H (1.11 ft ³ /kVA)	115 or 230 VAC 1 phase, 400 Hz 14.5 x 11.25 x 6.875H (0.649 ft ³ /kVA)	115 or 230 VAC 1 phase, 50 or 60 Hz 19 x 19 x 14H (1.46 ft ³ /kVA)	115 or 230 VAC 1 phase, 400 Hz 19 x 19 x 14H (1.46 ft ³ /kVA)
Size	100 lb	70 lb	200 lb	140 lb
Weight	(100 lb/kVA)	(70 lb/kVA)	(100 lb/kVA)	(70 lb/kVA)
Voltage Req	1%	1%	1%	1%
Frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
0 < P ≤ 5 kW

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model				
Rating	3K60XX	3K400XX	5K60XX	5K400XX
Input	3 kVA	3 kVA	5 kVA	5 kVA
Output	24 or 48 or 120 VDC	24 VDC	48 or 120 VDC	120 VDC
Size	115 or 230 VAC 1 phase, 50 or 60 Hz 19 x 19 x 14 1/2	115 or 230 VAC 1 phase, 400 Hz 19 x 19 x 14 1/2	115 or 230 VAC 1 phase, 50 or 60 Hz 24 x 17 x 21 1/2	115 or 230 VAC 1 phase, 400 Hz 24 x 17 x 21 1/2
Weight	(0.975 ft ³ /kVA) 250 lb (83.3 lb/kVA)	(0.975 ft ³ /kVA) 160 lb (53.3 lb/kVA)	(0.992 ft ³ /kVA) 265 lb (53.0 lb/kVA)	(0.992 ft ³ /kVA) 205 lb (41.0 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
0 < P < 5kW

Table 2. (Continued).

Company	California Instruments	California Instruments	California Instruments	California Instruments
Model	101T	161T	251T	251TC
Rating	0.10kVA	0.16kVA	0.25kVA	0.25kVA
Input	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz
Output	0 to 135 VAC 45 to 10000 Hz 21 x 19 x 3 1/2H	0 to 120 VAC 45 to 5000 Hz 21 x 19 x 3 1/2H	0 to 30, 0 to 75 0 to 135 VAC 45 to 20000 Hz 21 x 19 x 5 1/4H	0 to 135, 0 to 270 VAC 45 to 5000 Hz 21 x 19 x 5 1/4H
Size	(8.08 ft ³ /kVA) 35 lb	(5.05 ft ³ /kVA) 35 lb	(4.85 ft ³ /kVA) 60 lb	(4.85 ft ³ /kVA) 70 lb
Weight	(350 lb/kVA)	(219 lb/kVA)	(240 lb/kVA)	(280 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	0.9%	0.9%	0.9%	0.9%
Environment	0 to 55°C	0 to 55°C	0 to 55°C	0 to 55°C

INVERTER
0 < P ≤ 5kW

Table 2. (Continued).

Company	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.
Model	2597-23	2598	2569-23	2682
Rating	\$5380 (\$2.15/VA)	\$5670 (\$2.27/VA)	\$8485 (\$1.70/VA)	\$8540 (\$1.73/VA)
Input	2.5kVA	2.5kVA	5.0kVA	5.0kVA
Output	48 or 125VDC	48 or 125VDC	48 or 125VDC	48 or 125VDC
Size	115VAC, 60Hz 21 x 19 x 14H	230VAC, 50Hz 21 x 19 x 14H	115VAC, 60Hz 21 x 19 x 21H	230VAC, 60Hz 21 x 19 x 21H
Weight	(1.29 ft ³ /kVA) 185 lb	(1.29 ft ³ /kVA) 185 lb	(0.97 ft ³ /kVA) 265 lb	(0.97 ft ³ /kVA) 265 lb
Voltage Reg	(74 lb/kVA) 2%	(74 lb/kVA) 2%	(53 lb/kVA) 2%	(53 lb/kVA) 2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

INVERTER
0 < P ≤ 5kW

Table 2. (Continued).

Company	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.
Model	55X1	53XX	55X2	55X3
Rating	\$5545, #5511 (\$3.47/VA)	\$2770, #5323 (\$2.77/VA)	\$5375, #5512 (\$2.69/VA)	\$5535, #5513 (\$2.77/VA)
Input	1.6 kVA	1.0 kVA	2.0 kVA	2.0 kVA
Output	12 or 24 or 28 VDC	12 or 24 or 28 or 48 or 125 VDC	12 or 24 or 28 VDC	12 or 24 or 28 VDC
Size	115 or 230 VAC, 50 Hz 13 x 19 x 14H	115 or 230 VAC, 60 Hz 13 x 19 x 7H	115 VAC, 60 Hz 13 x 19 x 14H	115 or 230 VAC, 50 Hz 13 x 19 x 14H
Weight	(1.25 ft ³ /kVA) 190 lb	(1.0 ft ³ /kVA) 95 lb	(1.0 ft ³ /kVA) 190 lb	(1.0 ft ³ /kVA) 190 lb
Voltage Reg	2%	(119 lb/kVA) 2%	(95 lb/kVA) 2%	(95 lb/kVA) 2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	-10 to 55°C 0 to 90%	-10 to 55°C 0 to 90%	-10 to 55°C 0 to 90%	-10 to 55°C 0 to 90%

X denotes input voltage

Table 2. (Continued).

INVERTER
 $0 < P \leq 5 \text{ kW}$

Company	Bendix Corp	EMP Electronics	Leland
Model			
Rating	39BL69-4	PS304C	ASH634-2
Input	1 kVA	0.25 kVA	0.125 kVA
Output	28 VDC	28 VDC	24 to 32 VDC
Size	115 VAC, 1 phase, 400 Hz 11.3 x 5.5 x 7H	115 VAC, 400 Hz 9 1/4 x 4 3/4 x 6 1/4H	26 or 115 VAC 1 phase, 400 Hz 8.15 x 5 x 2.72H
Weight	(0.252 ft ³ /kVA) 20 lb	(0.636 ft ³ /kVA) 9 lb	(0.513 ft ³ /kVA) 4.3 lb
Voltage Reg	(20 lb/kVA)	(36 lb/kVA)	(34.4 lb/kVA)
Frequency Regulation			
Harmonic Distortion		5%	5%
Environment	-55 to 85°C 65000 ft	-55 to 71°C	-55 to 71°C 55000 ft

INVERTERS
5 < P ≤ 15kW

Table 2. (Continued).

Company	Varo	Varo		Powertronic Systems Inc.	Elgar Corp
Model					
Rating	4345	4406			INV-103
Input	6.5kW	10kW		14kVA	10kVA
Output	210-335VDC	180-355VDC		180VDC	105-140VDC
Size	115v, 3 phase, 400Hz	120v, 3 phase, 400Hz		120VAC, 3 phase, 0-700Hz	120VAC
Weight					19 x 44 x 78H (3.77 ft ³ /kVA)
					1400 lb (140 lb/kVA)
Voltage Reg				1%	2%
Frequency Regulation				0.01%	0.25%
Harmonic Distortion				2% (output)	5%
Environment				65°C 100%RH	0 to 40°C

INVERTER
5 < P ≤ 15 kW

Table 2. (Continued).

Company	Leland	Nova Electric	Nova Electric	Nova Electric
Model	ASH724-1	7.5K60XX	7.5K-3/6-XX	10K60XX
Rating	5.6 kW	7.5 kVA	7.5 kVA	10 kVA
Input	33 VDC	120 or 240 VDC	24 or 48 or 120 or 240 VDC	120 or 240 VDC
Output	120 or 208 VAC 3 phase, 400 Hz 19.6 x 15.4 x 10.5H	115 or 230 VAC 1 phase, 50 or 60 Hz 24 x 17 x 42H	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 63H	115 or 230 VAC, 3 phase 1 phase, 50 or 60 Hz 30 x 22 x 32H
Size	(0.328 ft ³ /kVA) 98 lb	(1.32 ft ³ /kVA) 405 lb	(1.98 ft ³ /kVA) 615 lb	(1.22 ft ³ /kVA) 550 lb
Weight	(17.5 lb/kVA)	(54 lb/kVA)	(82 lb/kVA)	(55 lb/kVA)
Voltage Reg	5%	1%	1%	1%
Frequency Regulation		0.15%	0.15%	0.15%
Harmonic Distortion		5%	5%	5%
Environment	-46 to 65°C 10000 ft	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

Table 2. (Continued).

INVERTER
5 < P ≤ 15kW

Company	Topaz Powermark Div. 2101	Topaz Powermark Div. 2683	Nova Electric	Nova Electric
Model	\$15480 (\$1.55/VA)	\$15570 (\$1.56/VA)	10K-3/6-XX	15K-3/6-XX
Rating	10.0kVA	10.0kVA	10kVA	15 kVA
Input	125 or 250VDC	125 or 250VDC	48 or 120 or 240 VDC	48 or 120 or 240 VDC
Output	115VAC, 60Hz 31 x 23 1/4 x 62H	230VAC, 60Hz 31 x 23 1/4 x 62H	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 42H	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 63H
Size	(2.59 ft ³ /kVA)	(2.59 ft ³ /kVA)	(0.992 ft ³ /kVA)	(0.992 ft ³ /kVA)
Weight	700 lb	700 lb	530 lb	800 lb
Voltage Reg	2%	(70 lb/kVA)	(53 lb/kVA)	(53.3 lb/kVA)
Frequency Regulation	0.5%	0.5%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	-20 to 50°C	-20 to 50°C

X denotes input voltage

Table 2. (Continued).

INVERTER
5 < P ≤ 15 kW

Company	Nova Electric				
Model					
Rating	10K400XX				
Input	10 kVA				
Output	120 VDC				
Size	115 or 230 VAC 1 phase, 400 Hz 30 x 22 x 32H				
Weight	(1.22 ft ³ /kVA) 405 lb				
Voltage Reg	1%				
Frequency Regulation	0.15%				
Harmonic Distortion	5%				
Environment	-20 to 50°C				

x denotes input voltage

Table 2. (Continued).

INVERTER
15 < P ≤ 60 kW

Company	Nova Electric	Nova Electric	Elgar Corp	
Model	20K-3/6-XX	30K-3/6-XX	INV-203	
Rating	20 kVA	30 kVA	20 kVA	
Input	120 or 240 VDC	120 or 240 VDC	105 to 140 VDC	
Output	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 30 x 44 x 32H	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 30 x 66 x 32H	120 VAC 24 x 54 x 80H	
Size	(1.22 ft ³ /kVA)	(1.22 ft ³ /kVA)	(3.0 ft ³ /kVA)	
Weight	1100 lb	1650 lb	2000 lb	
Voltage Reg	1%	1%	2%	
Frequency Regulation	0.15%	0.15%	0.25%	
Harmonic Distortion	5%	5%	5%	
Environment	-20 to 50°C	-20 to 50°C	0 to 40°C	

X denotes input voltage

Table 2. (Continued).

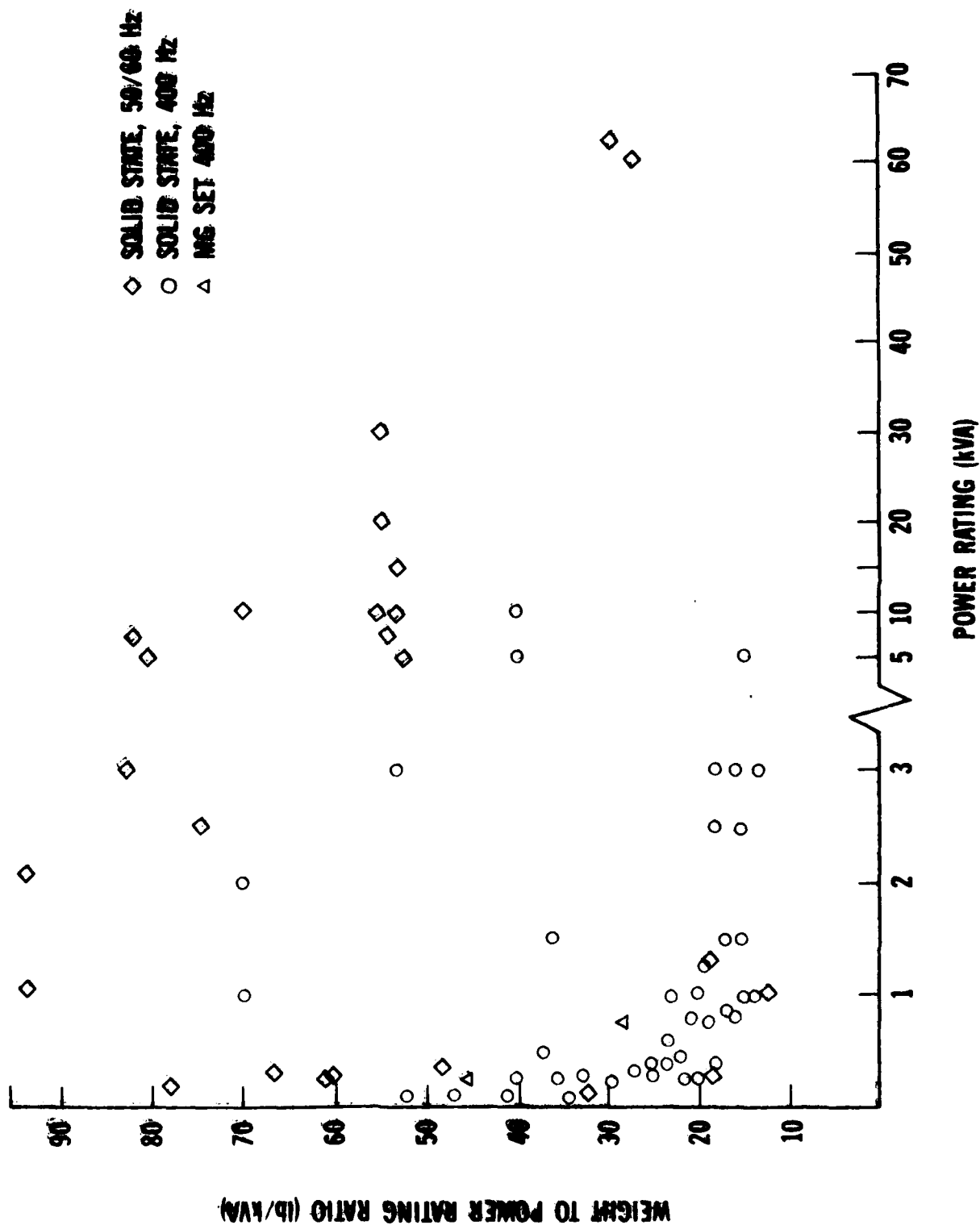
INVERTER
 $15 < P \leq 60 \text{ kW}$

Company	CTS of Canada	CTS of Canada			
Model					
Rating	8000	8300			
Input	40 kVA	125 kVA			
Output	up to 275 VDC	up to 275 VDC			
Size	various, 1 phase, 50 or 60 or 400 Hz	various, 1 phase, 50 or 60 or 400 Hz			
Weight					
Voltage Reg	2%	2%			
Frequency Regulation	0.01%	0.01%			
harmonic Distortion	3 to 5%	3 to 5%			
Environment	32 to 132°F 95%RH 10,000 ft	32 to 132°F 95%RH 10,000 ft			

Table 2. (Continued).

INVERTERS
60kW < P ≤

Company	Westinghouse	DEOC	DEOC	
Model				
Rating	AVI-623	61264	61240	
Input	62.5kW or kVA	75kW	300kW	
Output	200-300VDC	180-290VDC	300-450VDC	
Size	120 or 277 VAC 3 phase 4 wire 60Hz 33 x 33 x 82H (0.83 ft ³ /kVA)	480v 3 phase, 60Hz 36 x 84 x 76H (1.77 ft ³ /kVA)	480v 3 phase, 60Hz 1m x 3.5m x 2mH (0.824 ft ³ /kVA)	
Weight	1830 lb (29 lb/kVA)			
Voltage Reg	+ 5%			
Frequency Regulation	I 3.33%			
Harmonic Distortion	THD = 5% max	3% current (output)	3% current (output)	
Environment	-10 to 45°C 0-96%RH noncondensing 790-520mm Hg			



3. Converters, a.c. to d.c. (Table 3). The a.c. to d.c. converters are used to generate a regulated d.c. output from an a.c. source. Battery chargers, d.c. power supplies, and transformer rectifier units are examples of this function. Although the Goodall units conform to military specifications, they do not appear as outstanding candidates for Army tactical applications because of weight to power ratio (60 lb/kVA to 200 lb/kVA) and narrow operating temperature range (23° C to 50° C). The Aerospace Avionics unit has a narrow temperature range (0° C to 50° C). The Bendix units have power to weight ratios of about 3 lb/kVA; these are 400-Hz units.

CONVERTERS AC TO DC
0 < P ≤ 5kW

Table 3.

Company	Aerospace Avionics	Good-All Electric	Good-All Electric	Good-All Electric
Model				
Rating	150A converter	MIL-P 15736/4	MIL-P 15736/7	MIL-C-24095
Input	150A @ 24V, 3.6kW	1.6kW	1.6kW	2kW
Output	117/208 VAC, 60 or 400Hz	440 VAC, 3 phase, 60Hz	208/440, 3 phase, 60Hz	115V, 1 phase, 60Hz
Size	24-30 VDC	26-40 VDC 18 x 22 x 30H	26-40 VDC 10 x 16 x 24H	2.5, 7.5, 10, 15, 30, 45 VDC 12 x 18 x 19H
Weight		(4.3 ft ³ /kVA) 320 lb	(1.4 ft ³ /kVA) 175 lb	(1.2 ft ³ /kVA) 125 lb
Voltage Reg	.5%	(200 lb/kVA) + 1%	(100 lb/kVA) + 1%	(62 lb/kVA) + 1%
Frequency Regulation				
Harmonic Distortion		1% ripple	1% ripple	1% ripple
Environment	0-50°C	23°C-50°C 100%RH 10,000ft elevation Outdoor enclosure	23-50°C 100%RH 10,000 ft elevation Outdoor enclosure	23-50°C 100%RH 10,000ft elevation Outdoor enclosure

CONVERTERS AC TO DC
5 < P ≤ 15kW

Table 3. (Continued).

Company	Good-All Electric	Good-All Electric	Bendix Corp	Bendix Corp
Model				
Rating	DOD-C-24529	MIL-P-15736/1	9B40-1	9B40-15
Input	8.5 kW	10kW	5.2kVA	7.2kVA
Output	440v, 3 phase, 60Hz	440v, 3 phase, 60Hz	200VAC, 3 phase, 400Hz	200VAC, 3 phase, 400Hz
Size	12.5-15 VDC 25-30 VDC 32.5-45 VDC 19 x 26 x 38H (1.3 ft ³ /kVA)	26-32 VDC 24 x 24 x 48H (1.6 ft ³ /kVA)	28VDC 10 x 6.1 x 6.3H (0.043 ft ³ /kVA)	28VDC 10.5 x 7.4 x 7.2H (0.045 ft ³ /kVA)
Weight	650 lb (76 lb/kVA)	850 lb (85 lb/kVA)	17 lb (3.27 lb/kVA)	21 lb (2.92 lb/kVA)
Voltage Reg	+ 1%	+ 1%		
Frequency Regulation				
Harmonic Distortion	1% ripple	1% ripple		
Environment	23-50°C 100%RH 10,000ft elevation Outdoor enclosure	23-50°C 100%RH 10,000ft elevation Outdoor enclosure	60,000 ft	

CONVERTERS DC to DC
 $0 < P \leq 5kW$

Table 3. (Continued).

Company	Flite-Tronics	Flite-Tronics	KGS Electronics	KGS Electronics
Model	PC - 6B	PC - 12A		
Rating	\$535 (\$1.95/VA)	\$535 (\$2.03/VA)	BC 14	BC 28
Input	.275kVA	.263kVA	.07kVA	.07kVA
Output	13.5VDC	28.0VDC	20 - 36VDC	20 - 36VDC
Size	27.5VDC 8 1/4 x 4 9/16 x 2 3/4H	13.2VDC 8 1/4 x 4 9/16 x 2 3/4H	14VDC 5.8 x 2.3 x 2.3H	28VDC 5.8 x 2.3 x 2.3H
Weight	(0.218 ft ³ /kVA) 3.4 lb (12.4 lb/kVA)	(0.228 ft ³ /kVA) 4 lb 2 oz (15.7 lb/kVA)	(0.254 ft ³ /kVA) 1.5 lb (21.4 lb/kVA)	(0.254 ft ³ /kVA) 1.5 lb (21.4 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
170°F			-55 to 71°C 50,000 ft	-55 to 71°C 50,000 ft

Table 3. (Continued).

CONVERTERS DC to DC
 $0 < P \leq 5 \text{ kW}$

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model				
Rating	EAL 2808	LS 120	LT 51	LT 52A
Input	.07kVA	.112kVA	.075kVA	.05kVA
Output	20 - 36VDC	20 - 36VDC	20 - 40VDC	20 - 40VDC
Size	28VDC 8.25 x 4.5 x 3.55H	28VDC 5.75 x 2.25 x 2.25H	5VDC 6.8 x 2.4 x 2.3H	0 - 5VDC adjustable 5.8 x 2.3 x 2.3H
Weight	(1.09 ft ³ /kVA) 2.5 lb (35.7 lb/kVA)	(0.15 ft ³ /kVA) 1.5 lb (13.4 lb/kVA)	(0.29 ft ³ /kVA) 1.5 lb (20 lb/kVA)	(0.355 ft ³ /kVA) 1.5 lb (30 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-55 to 70°C 45,000 ft	-55 to 71°C	-55 to 71°C	-55 to 71°C

Table 3. (Continued).

CONVERTERS DC to DC
 $0 < P \leq 5\text{kW}$

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	LT 55	LT 70	LT 71	LT 100
Rating	.075kVA	.07kVA	.112kVA	.10kVA
Input	20 - 36VDC	20 - 40VDC	20 - 40 VDC	20 - 40VDC
Output	0 - 5VDC adjustable 5.2 x 3.4 x 2.7H	0 - 12VDC adjustable 5.8 x 2.3 x 2.3H	14VDC 6.8 x 2.4 x 2.3H	0 - 28VDC adjustable 5.8 x 2.3 x 2.3H
Size	(0.368 ft ³ /kVA) 1.5 lb	(0.254 ft ³ /kVA) 1.5 lb	(0.194 ft ³ /kVA) 1.5 lb	(0.178 ft ³ /kVA) 1.5 lb
Weight	(20 lb/kVA)	(21.4 lb/kVA)	(13.4 lb/kVA)	(15 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-55 to 70°C 50,000 ft	-55 to 70°C	-55 to 71°C	-55 to 71°C

CONVERTERS DC to DC
 $0 < P \leq 5\text{kW}$

Table 3. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model				
Rating	LT 101	PB 50	RB 125	RB 126
Input	.100kVA	.05kVA	.14kVA	.168kVA
Output	20 - 40VDC	11 - 30VDC	11 - 16VDC	13.5 - 16VDC
Size	28VDC 6.8 x 2.4 x 2.3H (0.217 ft ³ /kVA)	28VDC 4 1/2 x 2 1/2 x 2 7/8H (0.374 ft ³ /kVA)	28VDC 5.8 x 2.3 x 2.3H (0.127 ft ³ /kVA)	28VDC 5.8 x 2.3 x 2.3H (0.106 ft ³ /kVA)
Weight	1.5 lb (15 lb/kVA)	1.5 lb (30 lb/kVA)	1.5 lb (10.7 lb/kVA)	1.5 lb (8.93 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-55 to 71°C	-65 to 165°F	-55 to 71°C	-55 to 71°C

CONVERTERS DC to DC
 $0 < P \leq 5kW$

Table 3. (Continued).

Company	KGS Electronics	KGS Electronics		
Model	UC 14 - 28	UC 28 - 14		
Rating	.275kVA	.24kVA		
Input				
Output	13.5VDC	28VDC		
Size	27.5VDC 8.25 x 4.56 x 2.75H (0.218 ft ³ /kVA)	13.2VDC 8.25 x 4.56 x 2.75H (0.249 ft ³ /kVA)		
Weight	3.4 lb (12.4 lb/kVA)	4 lb 2 oz (17.2 lb/kVA)		
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-55 t 70°C 45,000 ft	-55 to 70°C 45,000 ft		

4. Uninterruptible Power Supplies (UPS) (Table 4). UPS are used to provide an unbroken supply of power for critical equipment or functions during temporary interruption of the primary power source. A complete UPS system includes a standby source of power to provide this no-break capability. The duration of the interruption during which the UPS system can provide power is determined by the energy capacity of the standby source (in relation to the load/power requirements). An UPS capability is of major importance to some military systems as represented by the power line conditioner in the communication system control element being developed by PM TRITAC.

A typical UPS system may consist of a rectifier/battery charger section operating from the primary a.c. supply, a battery bank which serves as the standby energy source, and an inverter section to provide a.c. power of suitable quality to the load, operating either from the rectified input or the battery bank. Such systems typically find use in critical computer systems or for solar power backup.

In the power range of less than 5 kW, none of the units reported has characteristics which are especially useful for military field applications. The operating temperature ranges are narrow (e.g., -10°C to $+40^{\circ}\text{C}$ is the widest range.). The weight to power ratios are in the 10^2 lb/kVA range. Voltage regulation is not within MIL-STD-1332 requirements for precise power, although frequency regulation is within that specification. Most models have voltage regulation within the 4-percent utility power definition. All the units are single frequency in and out.

In the 5-kW to 15-kW range, the same comments apply with the exception that Gould systems such as 6156-X and Exide systems such as 2710 have voltage regulation of 1 percent, which complies with MIL-STD-132 for precise power.

UNINTERRUPTIBLE POWER SUPPLIES
0 < P ≤ 5kW

Table 4.

Company	Cyberex	Cyberex	Cyberex	Cyberex
Model				
Rating	110CV1-STS-50	120CV1-STS	110-CV2-STS-50	120CV2-STS
Input	1kVA	1kVA	2kVA	2kVA
Output	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz
Size	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1334mmH (23 ft ³ /kVA)	120v, 1 phase, 60Hz 23 5/8 x 33 1/3 x 52 1/2H (24 ft ³ /kVA)	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1334mmH (23 ft ³ /kVA)	120v, 1 phase, 60Hz 23 5/8 x 33 1/3 x 52 1/2H (24 ft ³ /kVA)
Weight	202 kg	445 lb	407 kg	897 lb
Voltage Reg	+3%, -4%	(444 lb/kVA)	(448 lb/kVA)	(448 lb/kVA)
Frequency Regulation	1/2%	+2%, -3%	+3%, -4%	+2%, -3%
Harmonic Distortion	5% (output)	1/2%	1/2%	1/2%
Environment	5% (output)	5% (output)	5% (output)	5% (output)
	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH

UNINTERRUPTIBLE POWER SUPPLIES
0 < P ≤ 5kW

Table 4. (Continued).

Company	Cyberex	Cyberex	Cyberex	Cyberex
Model				
Rating	110CV3-ST5-50	120CV3-ST5	110CV5-ST5-50	120CV5-ST5
Input	3kVA	3kVA	5kVA	5kVA
Output	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz	220v, 1 phase, 50Hz	220v, 1 phase, 60Hz
Size	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1873mmH (11 ft ³ /kVA)	120v, 1 phase, 60Hz 23 5/8 x 32 1/4 x 73 3/4H (11 ft ³ /kVA)	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1873mmH (6.6 ft ³ /kVA)	120v, 1 phase, 60Hz 23 5/8 x 32 1/4 x 73 3/4H (6.6 ft ³ /kVA)
Weight	585 kg (429 lb/kVA)	1290 lb (430 lb/kVA)	651 kg (286 lb/kVA)	1436 lb (287 lb/kVA)
Voltage Reg	+3%, -4%	+2%, -3%	+3%, -4%	+2%, -3%
Frequency Regulation	1/2%	1/2%	1/2%	1/2%
Harmonic Distortion	5% (output)	5% (output)	5% (output)	5% (output)
Environment	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH

UNINTERRUPTIBLE POWER SUPPLIES
0 < P ≤ 5kW

Table 4. (Continued).

Company	Elgar	Gould	Gould	Gould
Model				
Rating	UPS 102-1B	DSU 20 series	DSU 20 series	DSU 20 series
Input	1kVA	0.500kVA	0.750kVA	1kVA
Output	120v, 1 phase, 57-63Hz	120v, 57-63Hz	120v, 57-63Hz	120v, 57-63Hz
Size	120v, 1 phase, 60Hz 20 x 19 x 8 3/4H	120v, 60Hz	120v, 60Hz	120v, 60Hz
Weight	(1.92 ft ³ /kVA) 100 lb			
Voltage Reg	2%	3%	3%	3%
Frequency Regulation	0.00%	0.5%	0.5%	0.5%
Harmonic Distortion	5% (output)	5% (output)	5% (output)	5% (output)
Environment	-10°C to 40°C 0-95%RH noncondensing	0°C to 40°C	0°C to 40°C	0°C to 40°C

Table 4. (Continued).

UNINTERRUPTIBLE POWER SUPPLIES
 $1 < p \leq 5 \text{ kW}$

Company	Gould	Gould	Gould	Gould
Model	DSU 20 series	DSU 20 series	DSU 20 series	524X
Rating	1.2kVA	1.5kVA	1.8kVA	3kVA
Input	120v, 57-63Hz	120v, 57-63Hz	120v, 57-63Hz	120 or 240v, 60Hz (48 or 125 DC)
Output	120v, 60Hz	120v, 60Hz	60Hz	120v, 1 phase, 60Hz 32 x 4 x 61H
Size				(1.5 ft ³ /kVA)
Weight				1050 lb (350 lb/kVA)
Voltage Reg	3%	3%	3%	
Frequency Regulation	0.5%	0.5%	0.5%	+0.5%
Harmonic Distortion	5% (output)	5% (output)	5% (output)	5% (output)
Environment	0°C to 40°C	0°C to 40°C	0°C to 40°C	

X = number specifying input voltage, phase and power

UNINTERRUPTIBLE POWER SUPPLIES
0 < P ≤ 5kW

Table 4. (Continued).

Company	Gould	Elgar Corp	Elgar Corp	Elgar Corp
Model				
Rating	524X	UPS-501-1-113	UPS-252-1	UPS-2525-1
Input	5kVA	0.5kVA	2.5kVA	2.5kVA
Output	120 or 240 or 480 or 208v (125v DC)	115VAC, 1 phase, 60Hz	115VAC, 1 phase, 60Hz	230VAC, 1 phase, 50Hz
Size	120v, 1 phase 32 x 4 x 61H	115VAC, 1 phase, 60Hz 19 x 19 x 7H	115VAC, 1 phase, 60Hz 19 x 19 x 14H	230VAC, 1 phase, 50Hz 19 x 19 x 19.25H
Weight	(0.9 ft ³ /kVA) 1300 lb	(2.92 ft ³ /kVA) 93 lb	(1.17 ft ³ /kVA) 213 lb	(1.61 ft ³ /kVA) 318 lb
Voltage Reg	(260 lb/kVA)	(186 lb/kVA)	(85.2 lb/kVA)	(127.2 lb/kVA)
Frequency Regulation	+0.5%	2%	2%	2%
Harmonic Distortion		0.25%	0.25%	0.25%
Environment	5% (output)	5%	5%	5%
X = number specifying input voltage, phase and power				
		0 to 40°C 95%RH	0 to 40°C 95%RH	0 to 40°C 95%RH

Table 4. (Continued).

UNINTERRUPTIBLE POWER SUPPLIES
0 < P ≤ 5kW

Company	Mawdsleys Limited	Mawdsleys Limited	Mawdsleys Limited	Elgar Corp
Model				UPS-102-1-136
Rating	1kVA	2kVA	5kVA	1kVA
Input	250 or 110VAC, single phase, 50 or 60Hz	250 or 110VAC, single phase, 50 or 60Hz	250 or 110VAC, single phase, 50 or 60Hz	115VAC, 1 phase, 60Hz
Output				
Size	as required, 50 or 60Hz 24 x 28 x 64H	as required, 50 or 60Hz 25.2 x 36 x 72H	as required, 50 or 60Hz 25.2 x 48 x 72H	115VAC, 1 phase, 60Hz 19 x 19 x 12.25H
Weight	(24.9 ft ³ /kVA) 572 lb	(18.9 ft ³ /kVA) 946 lb	(10.1 ft ³ /kVA) 1606 lb	(2.56 ft ³ /kVA) 198 lb
Voltage Reg	(572 lb/kVA) 5%	(473 lb/kVA) 5%	(321 lb/kVA) 5%	(198 lb/kVA) 2%
Frequency Regulation	0.5%	0.5%	0.5%	0.25%
Harmonic Distortion	3%	3%	3%	5%
Environment	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	0 to 40°C 95%RH

Table 4. (Continued).

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5kW$

Company	Elgar Corp				
Model	UPS-502-1A				
Rating	5kVA				
Input	115 or 230VAC 1 phase, 60Hz				
Output	115 or 230VAC 1 phase, 60Hz				
Size	17.5 x 43 x 60.5H (5.27 ft ³ /kVA)				
Weight	1050 lb (210 lb/kVA)				
Voltage Reg	2%				
Frequency Regulation	0.25%				
Harmonic Distortion	5%				
Environment	0 to 50°C 95%RH				

UNINTERRUPTIBLE POWER SUPPLIES
5 < P ≤ 15kW

Table 4. (Continued).

Company	Bogue	Cyberex	Cyberex	Gould
Model				
Rating	7537	110CV7.5-ST5-50	120CV7.5-ST5	5250
Input	7.5kW	7.5kVA	7.5kVA	7.5kVA
Output	120v, 3 phase, 60Hz	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz	208 or 480v, 3 phase (125v DC)
Size	120v, 1 phase, 60Hz	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1873mmH	120v, 1 phase, 60Hz 23 5/8 x 32 1/4 x 73 3/4H (4.4 ft ³ /kVA)	120v, 1 phase 32 x 29 x 61H (4.4 ft ³ /kVA)
Weight		900 kg	1800 lb	1500 lb
Voltage Reg	2%	(264 lb/kVA) +3%, -4%	(240 lb/kVA) +2%, -3%	(200 lb/kVA)
Frequency Regulation	3%	1/2%	1/2%	+0.5%
Harmonic Distortion		5% (output)	5% (output)	5% (output)
Environment		-10 to 40°C 0-95%RH	-10 to 40°C 0-95%RH	

UNINTERRUPTIBLE POWER SUPPLIES
5 < P ≤ 15kW

Table 4. (Continued).

Company	Gould	Gould	Gould	Exide Electronics
Model				
Rating	5254	5255	6156-X	2015
Input	10kVA	15kVA	15kVA	15kW, 18.75kVA
Output	208 or 480v, 3 phase (125v DC)	208 or 480v, 3 phase (125v DC)	208 or 480v, 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz
Size	120v, 1 phase 32 x 56 x 61H (6.3 ft ³ /kVA)	120v, 1 phase 32 x 56 x 61H (4.2 ft ³ /kVA)	120/208v, 60Hz	120/208 or 277/480 or 346/600 or 120/210 or 230/400VAC 3 phase, 50 or 60Hz 30 x 52 x 72H
Weight	2350 lb (235 lb/kVA)	2750 lb (183 lb/kVA)		(3.47 ft ³ /kVA) 850 lb (45.3 lb/kVA)
Voltage Reg			1%	1%
Frequency Regulation	+0.5%	+0.5%	0.5%	0.1%
Harmonic Distortion	5% (output)	5% (output)	5% (output) 10% (input)	5%
Environment				0 to 50°C 95%RH

X = number specifying input voltage

UNINTERRUPTIBLE POWER SUPPLIES
5 < P ≤ 15kW

Table 4. (Continued).

Company	Exide Electronics	Elgar Corp	Elgar Corp	Elgar Corp
Model				
Rating	2715	UPS-652-1A	UPS-103-1A	UPS-103-3A
Input	15kW, 18.75kVA	6.5kVA	10kVA	10kVA
Output	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	115 or 230VAC 1 phase, 60Hz	115 or 230VAC 1 phase, 60Hz	115 or 230VAC 3 phase, 60Hz
Size	120 or 230 or 240VAC 1 phase, 50 or 60Hz 30 x 52 x 72H	115 or 230VAC 1 phase, 60Hz 17.5 x 43 x 64.5H	115 or 230VAC 1 phase, 60Hz 19 x 55 x 72.5H	115 or 230VAC 3 phase, 60Hz 19 x 55 x 72.5H
Weight	(3.47 ft ³ /kVA) 850 lb	(4.32 ft ³ /kVA) 1250 lb	(4.38 ft ³ /kVA) 1800 lb	(4.38 ft ³ /kVA) 2000 lb
Voltage Reg	(45.3 lb/kVA) 1%	(192.3 lb/kVA) 2%	(180 lb/kVA) 2%	(200 lb/kVA) 1%
Frequency Regulation	0.1%	0.25%	0.25%	0.25%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
5 < P ≤ 15kW

Table 4. (Continued).

Company	Mawdsleys Limited	Mawdsleys Limited	Mawdsleys Limited	Exide Electronics
Model				2710
Rating	7kVA	10kVA	15kVA	10kW, 12.5kVA
Input	350 or 208VAC, 3 phase, 50 or 60Hz	350 or 208VAC, 3 phase, 50 or 60Hz	350 or 208VAC, 3 phase, 50 or 50Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz
Output				120 or 230 or 240VAC 1 phase, 50 or 60Hz 30 x 52 x 72H
Size	as required, 50 or 60Hz 25.2 x 56 x 72H	as required, 50 or 60Hz 25.2 x 64 x 72H	as required, 50 or 60Hz 25.2 x 64 x 72H	(5.2 ft ³ /kVA) 750 lb
Weight	(8.4 ft ³ /kVA) 2046 lb	(6.72 ft ³ /kVA) 2420 lb	(4.48 ft ³ /kVA) 2860 lb	(60 lb/kVA)
Voltage Reg	5%	5%	5%	1%
Frequency Regulation	0.5%	0.5%	0.5%	0.1%
Harmonic Distortion	3%	3%	3%	5%
Environment	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	0 to 50°C 95%RH

Table 4. (Continued).

UNINTERRUPTIBLE POWER SUPPLIES
 $5 < P \leq 15\text{kW}$

Company	Elgar Corp	Elgar Corp			
Model					
Rating	UPS-153-1	UPS-153-3A			
Input	15kVA	15kVA			
Output	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz			
Size	115 or 230VAC 1 phase, 60Hz 27 x 54 x 72H (4.05 ft ³ /kVA)	120 or 208VAC 3 phase, 60Hz 27 x 55 x 76.5H (4.38 ft ³ /kVA)			
Weight	2300 lb (153.3 lb/kVA)	2250 lb (150 lb/kVA)			
Voltage Reg	2%	1%			
Frequency Regulation	0.25%	0.25%			
Harmonic Distortion	5%	5%			
Environment	0 to 50°C 95%RH	0 to 50°C 95%RH			

UNINTERRUPTIBLE POWER SUPPLIES
15 < P ≤ 60kW

Table 4. (Continued).

Company	Elgar	Gould	Gould	Gould
Model				
Rating	UPS 503-3B	5256	6306-X	6456-X
Input	50kVA	20kVA	30kVA	45kVA
Output	120/208v, 3 phase (or 480v), 57 to 63Hz		208 or 480v, 60Hz	208 or 480v, 60Hz
Size	120/208v, 3 phase (or 480v), 60Hz		120/280v or 277/480v, 60Hz	120/208v or 277/480v, 60Hz
Weight		32 x 68 x 70H (3.9 ft ³ /kVA)		
Voltage Reg	2%	2950 lb (390 lb/kVA)		
Frequency Regulation	.01Hz	+3%	1%	1%
Harmonic Distortion	5% (output)	+0.5%	0.1Hz	0.1Hz
Environment		5% (output)	5% (output), 10% (input)	5% (output), 10% (input)
X = number specifying input and output combination				
		0-40°C	0-40°C	0-40°C

UNINTERRUPTIBLE POWER SUPPLIES
15 < P ≤ 60kW

Table 4. (Continued).

Company	Teledyne Inet Series 75	Elgar Corp	Elgar Corp	Elgar Corp
Model	\$42775 (\$0.57/VA)	UPS-183-3	UPS-203-1	UPS-253-3
Rating	60 kW 75kVA	17.5kVA	20kVA	25kVA
Input	208 or 480v cable, 60Hz	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Output	208 or 480v cable, 60Hz	120 or 208VAC 3 phase, 60Hz	115 or 230VAC 1 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Size	60 x 36 x 80H (1.4 ft ³ /kVA)	26 x 55 x 76.5H (3.62 ft ³ /kVA)	24 x 60 x 80H (3.33 ft ³ /kVA)	26.5 x 102.5 x 80H (5.03 ft ³ /kVA)
Weight	4400 lb (59 lb/kVA)	2550 lb (145.7 lb/kVA)	2600 lb (130 lb/kVA)	4004 lb (160.2 lb/kVA)
Voltage Reg	+ 1%	1%	2%	1%
Frequency Regulation	+ .05%Hz	0.25%	0.25%	0.25%
Harmonic Distortion	5% (output) 10% (input)	5%	5%	5%
Environment	0-40°C 0-95%RH 0-5000' elevation NEMA I enclosure	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
15 < P ≤ 60kW

Table 4. (Continued).

Company	Mawdsleys Limited	Mawdsleys Limited	Elgar Corp	Elgar Corp
Model				
Rating			UPS-373-3	UPS-453-3
Input	20kVA	25kVA	37.5kVA	45kVA
Output	350 or 208VAC, 3 phase, 50 or 60Hz	350 or 208VAC, 3 phase, 50 or 60Hz	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Size	as required, 50 or 60Hz 25.2 x 100 x 72H	as required, 50 or 60Hz 25.2 x 100 x 72H	120 or 208VAC 3 phase, 60Hz 26.5 x 102.5 x 80H	120 or 208VAC 3 phase, 60Hz 26.5 x 102.5 x 80H
Weight	(5.25 ft ³ /kVA) 3740 lb	(4.2 ft ³ /kVA) 4180 lb	(3.35 ft ³ /kVA) 4700 lb	(2.79 ft ³ /kVA) 5100 lb
Voltage Reg	(187 lb/kVA) 5%	(167 lb/kVA) 5%	(125.3 lb/kVA) 1%	(113.3 lb/kVA) 1%
Frequency Regulation	0.5%	0.5%	0.25%	0.25%
Harmonic Distortion	3%	3%	5%	5%
Environment	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
15 < P ≤ 60kW

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Franklin Electric	Franklin Electric
Model				
Rating	3060	5060	550	650
Input	60kW, 75kVA	60kW, 75kVA	50kVA	50kVA
Output	208 or 480 or 600VAC 3 phase, 60Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	380 or 400 or 415VAC 3 phase, 50Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz
Size	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz 32 x 64 x 84H	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz 40 x 64 x 82H	380 or 400 or 415VAC 3 phase, 50Hz 36 x 72 x 72H	120 or 208 or 277 or 480VAC, 3 phase, 60Hz 36 x 72 x 72H
Weight	(1.33 ft ³ /kVA) 4720 lb	(1.62 ft ³ /kVA) 5182 lb	(2.16 ft ³ /kVA) 4000 lb	(2.16 ft ³ /kVA) 4000 lb
Voltage Reg	1%	(62.9 lb/kVA) 1%	(80 lb/kVA) 1%	(80 lb/kVA) 1%
Frequency Regulation	+0.06Hz	+0.05Hz	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 40°C 95%RH	0 to 40°C 95%RH 4000 ft	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft

UNINTERRUPTIBLE POWER SUPPLIES
15 < P ≤ 60kW

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model	2720	2030	2730	2045
Rating	20kW, 25kVA	30kW, 37.5kVA	30kW, 37.5kVA	45kW, 56.25kVA
Input	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz
Output	120 or 230 or 240VAC 1 phase, 50 or 60Hz 30 x 52 x 72H	120/208 or 277/480 or 346/600 or 120/210 or 230/400VAC 3 phase, 50 or 60Hz 30 x 52 x 72H	120 or 230 or 240VAC 1 phase, 50 or 60Hz 30 x 52 x 72H	120/208 or 277/480 or 346/600 or 120/210 or 230/400VAC 3 phase, 50 or 60Hz 30 x 52 x 72H
Size	(2.6 ft ³ /kVA) 1100 lb	(1.73 ft ³ /kVA) 1200 lb	(1.73 ft ³ /kVA) 1200 lb	(1.16 ft ³ /kVA) 1750 lb
Weight	(44 lb/kVA)	(32 lb/kVA)	(32 lb/kVA)	(31.1 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.1%	0.1%	0.1%	0.1%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model	3100	5100	5150	3180
Rating	100kW, 125kVA	100kW	150kW, 187kVA	180kW, 225kVA
Input	208 or 480 or 600VAC 3 phase, 60Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	208 or 480 or 600VAC 3 phase, 60Hz
Output	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz
Size	32 x 126.6 x 82H	40.5 x 126.5 x 82H	40.5 x 126.5 x 82H	32 x 126.6 x 82H
Weight	(1.54 ft ³ /kVA) 6550 lb	(2.43 ft ³ /kVA) 8533 lb	(1.3 ft ³ /kVA) 10496 lb	(0.854 ft ³ /kVA) 8460 lb
Voltage Reg	(52.4 lb/kVA) 1%	(85.3 lb/kVA) 1%	(56.1 lb/kVA) 1%	(37.6 lb/kVA) 1%
Frequency Regulation	+0.06Hz	+0.05Hz	+0.05Hz	+0.06Hz
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 40°C 95%RH	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P ≤

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model				
Rating	5200	3250	5300	3330
Input	200kW, 250kVA	250kW, 313kVA	300kW, 375kVA	330kW, 412kVA
Output	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	208 or 480 or 600VAC 3 phase, 60Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	208 or 480 or 600VAC 3 phase, 60Hz
Size	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz 40.5 x 126.5 x 82H	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz 40 x 126.6 x 82H	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz 40.5 x 189 x 82H	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz 32 x 189.3 x 82H
Weight	(0.972 ft ³ /kVA) 12392 lb	(0.768 ft ³ /kVA) 11130 lb	(0.97 ft ³ /kVA) 15876 lb	(0.70 ft ³ /kVA) 11730 lb
Voltage Reg	(49.6 lb/kVA) 1%	(35.6 lb/kVA) 1%	(42.3 lb/kVA) 1%	(28.5 lb/kVA) 1%
Frequency Regulation	+0.05Hz	+0.06Hz	+0.05Hz	+0.06Hz
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P ≤

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model	3400	3450	5500	3600
Rating	400kW, 500kVA	450kW, 500kVA	500kW, 625kVA	600kW, 750kVA
Input	208 or 480 or 600VAC 3 phase, 60Hz	208 or 480 or 600VAC 3 phase, 60Hz	380VAC, 3 phase, 50Hz	480 or 600VAC 3 phase, 60Hz
Output	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz 32 x 189.3 x 82H	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz 32 x 189.3 x 82H	220/380VAC 3 phase, 50Hz 40.5 x 189 x 82H	277/480 or 346/600VAC 3 phase, 60Hz 40 x 189.3 x 82H
Size	(0.575 ft ³ /kVA) 13260 lb	(0.575 ft ³ /kVA) 14100 lb	(0.581 ft ³ /kVA) 22094 lb	(0.479 ft ³ /kVA) 17470 lb
Weight	(26.5 lb/kVA) 1%	(28.2 lb/kVA) 1%	(35.4 lb/kVA) 1%	(23.3 lb/kVA) 1%
Voltage Reg	+0.06Hz	+0.06Hz	+0.05Hz	+0.06Hz
Frequency Regulation	5%	5%	5%	5%
Harmonic Distortion	0 to 40°C 95%RH	0 to 40°C 95%RH	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH
Environment				

Table 4. (Continued).

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P ≤

Company	Franklin Electric	Franklin Electric	Franklin Electric	Franklin Electric
Model				
Rating	575	5100	5125	5150
Input	75kVA	100kVA	125kVA	150kVA
Output	380 or 400 or 415VAC 3 phase, 50Hz	380 or 400 or 415VAC 3 phase, 50Hz	380 or 400 or 415VAC 3 phase, 50Hz	380 or 400 or 415VAC 3 phase, 50Hz
Size	380 or 400 or 415VAC 3 phase, 50Hz 36 x 72 x 72H	380 or 400 or 415VAC 3 phase, 50Hz 36 x 72 x 72H	380 or 400 or 415VAC 3 phase, 50Hz 36 x 72 x 72H	380 or 400 or 415VAC 3 phase, 50Hz 36 x 72 x 72H
Weight	(1.44 ft ³ /kVA) 4700 lb	(1.08 ft ³ /kVA) 5300 lb	(0.864 ft ³ /kVA) 5600 lb	(0.72 ft ³ /kVA) 6000 lb
Voltage Reg	1%	(53 lb/kVA) 1%	(44.8 lb/kVA) 1%	(40 lb/kVA) 1%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Franklin Electric	Franklin Electric	Franklin Electric	Franklin Electric
Model				
Rating	675	6100	6125	6150
Input	75kVA	100kVA	125kVA	150kVA
Output	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz
Size	120 or 208 or 277 or 480VAC, 3 phase, 60Hz 36 x 72 x 72H (1.44 ft ³ /kVA)	120 or 208 or 277 or 480VAC, 3 phase, 60Hz 36 x 72 x 72H (1.08 ft ³ /kVA)	120 or 208 or 277 or 480VAC, 3 phase, 60Hz 36 x 72 x 72H (0.864 ft ³ /kVA)	120 or 208 or 277 or 480VAC, 3 phase, 60Hz 36 x 72 x 72H (0.72 ft ³ /kVA)
Weight	4700 lb (62.7 lb/kVA)	5300 lb (53 lb/kVA)	5600 lb (44.8 lb/kVA)	6000 lb (40 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Teledyne Inet Series 100	Teledyne Inet Series 125	Teledyne Inet Series 150	Teledyne Inet Series 200
Model	\$47206 (\$0.47/VA)	\$49636 (\$0.40/VA)	\$52065 (\$0.35/VA)	\$56925 (\$0.28/VA)
Rating	80kW, 100kVA	100kW, 125kVA	120kW, 150kVA	160kW, 200kVA
Input	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz
Output	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz
Size	208 or 480v, 60Hz 60 x 36 x 85.5H	208 or 480v, 60Hz 60 x 36 x 90.5H	208 or 480v, 60Hz 60 x 36 x 90.5H	208 or 480v, 60Hz 72 x 34 x 96H
Weight	(1 ft ³ /kVA) 4900 lb	(0.9 ft ³ /kVA) 5500 lb	(0.75 ft ³ /kVA) 6200 lb	(0.68 ft ³ /kVA) 6800 lb
Voltage Reg	+ 1%	+ 1%	+ 1%	+ 1%
Frequency Regulation	+ .05%	+ .05%	+ .05%	+ .05%
Harmonic Distortion	5%	5%	5%	5%
Environment	0-40°C 0-95%RH 0-5,000' elevation NEMA I enclosure	0-40°C 0-95%RH 0-5,000' elevation NEMA I enclosure	0-40°C 0-95%RH 0-5,000' elevation NEMA I enclosure	

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Teledyne Inet Series 250	Teledyne Inet Series 300	Teledyne Inet Series 375	Exide Electronics
Model	\$57745 (\$0.23/vA)	\$59585 (\$0.20/vA)	\$61775 (\$0.16/vA)	4080
Rating	200kW, 250kVA	240kW, 300kVA	300kW, 375kVA	80kW, 100kVA
Input	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480 or 600 280 or 415VAC 3 phase, 50 or 60Hz
Output	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz	120/208VAC, 3 phase 400 or 415 or 440Hz 32 x 64 x 82H
Size	208 or 480v, 60Hz 72 x 34 x 96H (0.54 ft ³ /kVA)	208 or 480v, 60Hz 72 x 34 x 96H (0.45 ft ³ /kVA)	208 or 480v, 60Hz 72 x 34 x 96H (0.36 ft ³ /kVA)	(0.911 ft ³ /kVA)
Weight	7500 lb (30 lb/kVA)	8100 lb (27 lb/kVA)	9500 lb (25 lb/kVA)	4300 lb (43 lb/kVA)
Voltage Reg	+1%	+1%	+1%	1%
Frequency Regulation	+0.5Hz	+0.5Hz	+0.5Hz	+1Hz
Harmonic Distortion	5% (output) 10% (input)	5% (output) 10% (input)	5% (output) 10% (input)	5%
Environment	0-45°C 0-95%RH 0-5,000' elevation NEMA 1 enclosure			0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
60 < P <

Table 4. (Continued).

Company	Franklin Electric	Franklin Electric			
Model					
Rating	5200	6200			
	200kVA	200kVA			
Input	380 or 400 or 415VAC 3 phase, 50Hz	120 or 208 or 277 or 480 or 600VAC 3 phase, 60Hz			
Output	380 or 400 or 415VAC 3 phase, 50Hz 36 x 72 x 72H	120 or 208 or 277 or 480 or 600VAC 3 phase, 60Hz 36 x 72 x 72H			
Size	(0.54 ft ³ /kVA) 6600 lb	(0.54 ft ³ /kVA) 6600 lb			
Weight	(33 lb/kVA) 1%	(33 lb/kVA) 1%			
Voltage Reg	1%	1%			
Frequency Regulation	0.5%	0.5%			
Harmonic Distortion	5%	5%			
Environment	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft			

In the power ranges 15 kW to 60 kW and 60 kW and above, there are several models by Gould, Teledyne Inet and Elgar which meet the precise power voltage and frequency regulation specifications of MIL-STD-1332. These models are single frequency in and out and are specified for an operating temperature range of 0° C to 40° C by Gould and Teledyne and 0° C to 50° C by Elgar. Teledyne Inet states that its models (series 75 through 500) are not adaptable to field use in rough terrains.

Basically, these units are intended for fixed installation and are for single-purpose applications. Weight to power ratios are shown in Figure 2 (these figures do not include the standby energy source.).

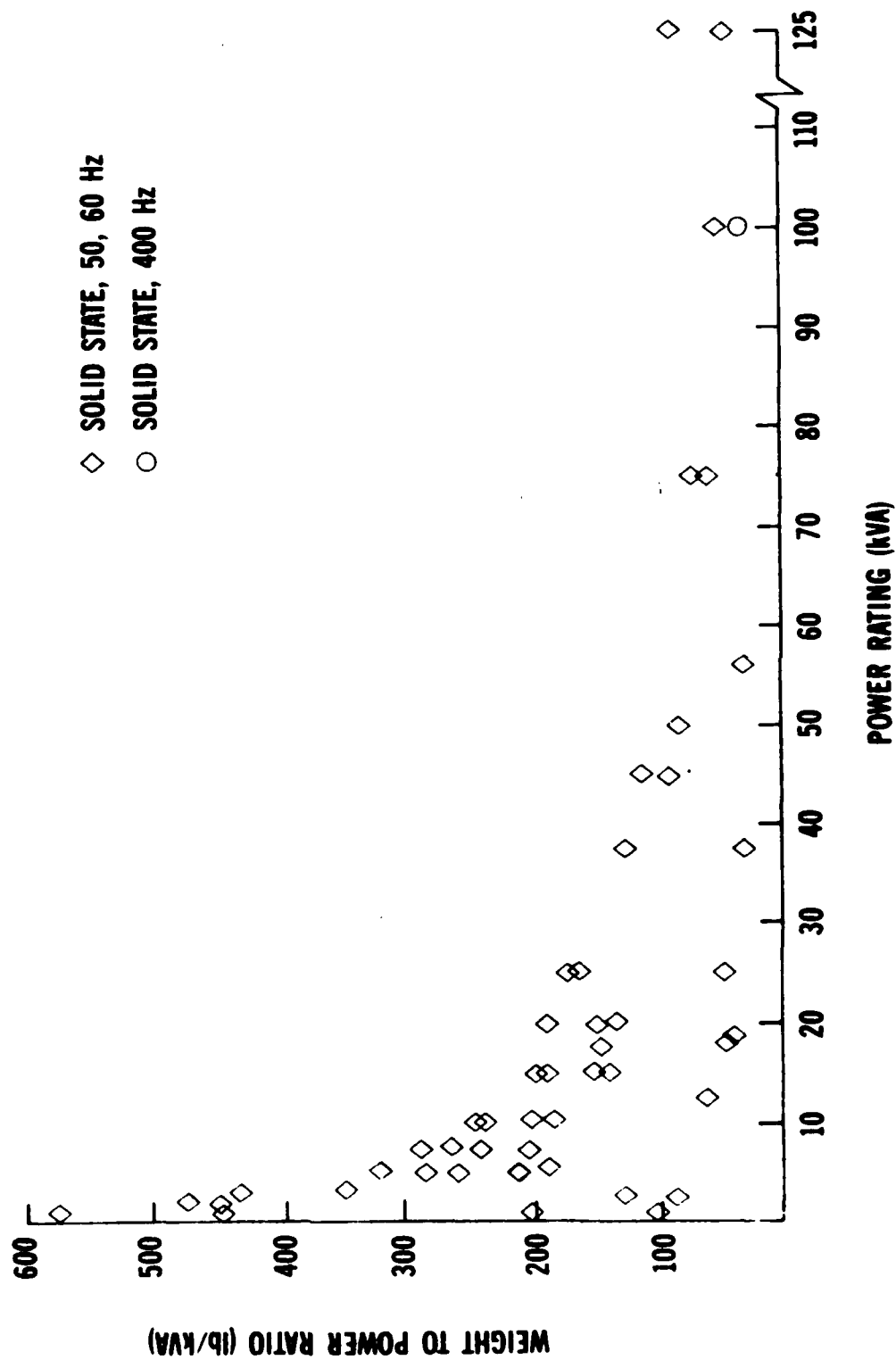


Figure 2. Weight to power rating ratio of uninterruptible power supplies vs power rating.

5. Frequency Changers (Table 5). Frequency changers are used to convert power available at one frequency to a different frequency required by the using equipment. Examples include supply of 400-Hz aircraft power from 60-Hz ground sources or conversion of 50 Hz to 60 Hz for equipment utilization in Europe and other OCONUS Theaters. The equipment reported here falls into two general categories: solid state static changers such as rectifier-inverter combinations and rotating machinery, such as motor-generator (MG) sets.

As a class, the MG sets tend to be heavier at a given power level than the solid state units, as shown in Figure 3. A similar relative trend is seen in the volume data, as shown in Figure 4.

The MG sets reported here are designed for single frequency in and out. In many cases, the output frequency is not controlled: In units based on synchronous machines, variations in the input frequency appear at the output. Except for d.c. motor control, this type of equipment does not lend itself to multi-input frequency designs.

Solid state systems in this category are designed for single frequency in and out, almost exclusively. A few solid state systems allow for a choice of frequency on order. They are intended for single-purpose application.

In the less than 5-kW power range, one unit from Teledyne Inet (CV-3231/V2) is built to military specifications. However, voltage regulation is ± 4 percent, outside precise requirements of MIL-STD 1332 but within the 4-percent utility power definition. Its weight to power ratio is about 40 lb/kVA. The operating temperature range is -33°C to $+52^{\circ}\text{C}$. Nova Electric models such as FC12XX allow a range of input frequencies. California Instruments Models such as 3001TC permit a range of input and output frequencies. These units are, essentially, laboratory power supplies.

FREQUENCY CHANGERS
 $0 < P \leq 5kW$

Table 5.

Company	Aerospace Avionics	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics
Model				
Rating	50 VA Freq Conv	SMG-5-51	SMG-5-53	SMG-5-401
Input	0.05kVA	4kW	4kW	4kW
Output	115 VAC 50-500Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz
Size	115 VAC, 400Hz 6 5/8 x 8 x 1 1/4H	120v, 1 phase 50 or 60Hz 25 x 17 x 21H	120/280v or 266/460v 50 to 60Hz 25 x 17 x 21H	120v, 1 phase, 400Hz 21.5 x 17 x 14H
Weight	(0.77 ft ³ /kVA) 14.5 lb	(1.04 ft ³ /kVA) 450 (485 parallelable) 1b (90 lb/kVA)	(1.04 ft ³ /kVA) 480 (510 parallelable) 1b (96 lb/kVA)	(0.6 ft ³ /kVA) 155 (170 parallelable) 1b (31 lb/kVA)
Voltage Reg	2%	1%	1%	0.5%
Frequency Regulation	1%	.01%	.01%	.01%
Harmonic Distortion	5% (output)	2% (output)	2% (output)	2% (output)
Environment	0-40°C Dripproof	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing

FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	California Instruments	California Instruments	California Instruments	California Instruments
Model	251T	251TC	351TC	501TC
Rating	0.25kVA	0.25kVA	0.35kVA	0.5kVA
Input	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz
Output				
Size	0-30 or 0-75 or 0-135VAC, 45 to 20,000Hz 21 x 19 x 5 1/4H (4.85 ft ³ /kVA)	0-135 or 0-270VAC 45 to 5,000Hz 21 x 19 x 5 1/4H (4.85 ft ³ /kVA)	0-120 or 0-240VAC 45 to 5,000Hz 21 x 19 x 5 1/4H (3.46 ft ³ /kVA)	0-135 or 0-270VAC 45 to 5,000Hz 21 x 19 x 7H (3.23 ft ³ /kVA)
Weight	60 lb (240 lb/kVA)	70 lb (280 lb/kVA)	70 lb (200 lb/kVA)	100 lb (200 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	0.9%	0.9%	0.9%	0.9%
Environment				
	-55 to 71°C	-55 to 71°C	-55 to 71°C	-55 to 71°C

FREQUENCY CHANGER
 $0 < P \leq 5kW$

Table 5. (Continued).

Company	California Instruments	California Instruments	California Instruments	California Instruments
Model	751TC	1001TC	1501TC	2501T
Rating	0.75KVA	1KVA	1.5KVA	2.5KVA
Input	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 210 or 250VAC 1 phase, 48 to 65Hz	208 or 220 or 230 or 370 or 416 or 440 or 460VAC 3 phase, 48 to 65Hz
Output				
Size	0-130 or 0-260VAC 45 to 5000Hz 21 x 19 x 7H (2.16 ft ³ /KVA)	0-130 or 0-260VAC 45 to 5000Hz 21 x 19 x 8 3/4H (2.02 ft ³ /KVA)	0-32.5 or 0-65 or 0-130 or 0-260VAC 45 to 5000Hz 21 x 19 x 14H (2.16 ft ³ /KVA)	0-30 or 0-60 or 0-120 or 0-240VAC 45 to 2000Hz 21 x 19 x 15 3/4H (1.45 ft ³ /KVA)
Weight	100 lb (133 lb/KVA)	140 lb (140 lb/KVA)	180 lb (120 lb/KVA)	240 lb (96 lb/KVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	0.9%	0.9%	0.9%	0.9%
Environment	-55 to 71°C	-55 to 71°C	-55 to 71°C	-55 to 71°C

FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	California Instruments	Nova Electric	Nova Electric	Nova Electric
Model				
Rating	3001TC	FC12XX	FC25XX	FC50XX
Input	3kVA	0.125kVA	0.25kVA	0.5kVA
Output	115 or 208 or 220 or 230 or 240VAC 3 phase, 48 to 65Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz
Size	0-32.5 or 0-65 or 0-130 or 0-260VAC 45 to 2000Hz 21 x 19 x 15 3/4H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 11 x 9 x 5 7/32H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 15 1/4 x 14 1/4 x 6 7/8H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 15 1/4 x 14 1/4 x 6 7/8H
Weight	(1.21 ft ³ /kVA) 240 lb	(2.39 ft ³ /kVA) 30 lb	(3.46 ft ³ /kVA) 65 lb	(1.73 ft ³ /kVA) 80 lb
Voltage Reg	(80 lb/kVA)	(240 lb/kVA)	(260 lb/kVA)	(160 lb/kVA)
Frequency Regulation		1%	1%	1%
Harmonic Distortion	0.9%	0.15%	0.15%	0.15%
Environment		4%	4%	4%
	-55 to 71°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes output frequency

FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model	FC1KXX	FC1K400	FC2KXX	FC3KXX
Rating	1kVA	1kVA	2kVA	3kVA
Input	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz
Output	115 or 220 or 240VAC 1 phase, 50 or 60Hz 17 x 17 x 8 3/4H	115 or 220 or 240VAC 1 phase, 400Hz 15 1/4 x 14 1/4 x 6 7/8H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 19 x 19 x 14H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 19 x 19 x 14H
Size	(1.44 ft ³ /kVA) 140 lb	(0.865 ft ³ /kVA) 73 lb	(1.46 ft ³ /kVA) 72.7 lb	(0.975 ft ³ /kVA) 120 lb
Weight	(140 lb/kVA)	(73 lb/kVA)	(36.4 lb/kVA)	(40 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion	4%	4%	4%	4%
Environment	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes output frequency

FREQUENCY CHANGERS
0 < P ≤ 5kW

Table 5. (Continued).

Company	A.L.S. Electronics	Bogue	Teledyne Inet	Teledyne Inet
Model	SMG-5-403	7330 (MG Set)	CV-3231/V-2	RHG 66-005 (MG Set)
Rating				
Input	4kW	5kW, 6.25kVA	4kW, 5kVA	5kW, 6.25kVA
Output	120/208 and/or 277/480 60Hz or 220/380 50Hz	220v, 3 phase, 60Hz	120/208v 4 wire 60Hz	480v 3 wire 60Hz
Size	120/208v or 120Y or 450 or 120 400Hz 21.5 x 17 x 14H (0.6 ft ³ /kVA)	115/220, 3 phase, 400Hz	120/208v 4 wire 400Hz 19 x 74 x 17 1/2H (2.8 ft ³ /kVA)	200v 4 wire 400Hz 39 x 40 x 56H (8 ft ³ /kVA)
Weight	165 (190 parallelable) lb (33 lb/kVA)	550 lb (88 lb/kVA)	200 lb (40 lb/kVA)	1700 lb (272 lb/kVA)
Voltage Reg	0.5%	1%	+4%	0.5%
Frequency Regulation	.01%	1%	+0.3%	Synchronous with input frequency
Harmonic Distortion	2% (output)	2% (output)	3% (output) 3% (input)	1.5% (output)
Environment	0-40°C 0-95%RH Noncondensing		-33 to 52°C 90%RH 8,000 ft elevation Drip-proof	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
0 < P ≤ 5kW

Table 5. (Continued).

Company	Teledyne Inet	Unitron	Unitron	Unitron
Model	RHG 64-005 (MG Set)	PS-65-225-8	PS-69-359	CR-024-3
Rating	5kW, 6.75kVA	0.4kVA	2.0kVA	2.5kVA
Input	480v 3 wire 60Hz	115/200v, 400Hz	115/200v, 400Hz	120/208v, 50/60Hz
Output	200v 4 wire 400Hz 39 x 40 x 56H	115v, 60Hz	115v, 50/60Hz	120/208v, 400Hz 24 x 19 x 17.5H
Weight	1700 lb (252 lb/kVA)	27 lb (67.5 lb/kVA)	80 lb (40 lb/kVA)	255 lb (102 lb/kVA)
Voltage Reg	0.5%	115 ±5.75 V RMS	115 ±3.0 V RMS	+2%
Frequency Regulation	Synchronous with input frequency	60 ±0.6Hz	60 ±0.6Hz	400 ±2Hz
Harmonic Distortion	1.5% (output)	5% (at load) output 8% (no load) output	5% (output)	2.0% (output)
Environment	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation			

FREQUENCY CHANGERS
0 < P ≤ 5kW

Table 5. (Continued).

Company	Unitron	Unitron	California Instruments	California Instruments
Model	PS-62-66D			
Rating	\$6885 (\$1.97/VA)	CR-054-3	153T	161T
Input	3.5kVA	5.0kVA	0.15kVA	0.16kVA
Output	115/200v, 400Hz	120/208v, 50/60Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz
Size	115v, 60Hz	120/208v, 400Hz 24 x 19 x 17.5H	0 -30 or 0-52 0-130 or 0-225VAC 3 phase, 45 to 20,000Hz 21 x 19 x 5 1/4H	0-120VAC 45 to 5000Hz 21 x 19 x 3 1/2H
Weight	95 lb	(0.92 ft ³ /kVA) 255 lb	(8.08 ft ³ /kVA) 70 lb	(5.05 ft ³ /kVA) 35 lb
Voltage Reg	(27 lb/kVA) 115 ±3.0 V RMS	(51 lb/kVA) ±2%	(467 lb/kVA)	(219 lb/kVA)
Frequency Regulation	60 ±0.6Hz	400 ±2Hz		
Harmonic Distortion	5% (output)	2.0% (output)	0.9%	0.9%
Environment			-55 to 71°C	-55 to 71°C

FREQUENCY CHANGERS
 $0 < P \leq 5kW$

Table 5. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPC 6-300F	SPC 6-750	SPC 6-750-30	SPS 1308-30
Rating	.3kVA	.75kVA	.75kVA	1kVA
Input	115VAC, 50 to 1,000Hz	115VAC, 50 to 1,000Hz	115VAC, 50 to 1,000Hz	115 or 208VAC 3 phase, 400Hz
Output	26 or 115VAC, 1 phase, 400Hz 17 x 13 x 7H	26 or 115VAC, 1 phase, 400Hz 17 x 13 x 7H	120 or 208VAC, 3 phase, 400Hz 17 x 13 x 7H	115VAC, 1 phase 60 to 64Hz 14 x 7 3/4 x 4H
Size	(2.98 ft ³ /kVA) 25 lb	(1.19 ft ³ /kVA) 30 lb	(1.19 ft ³ /kVA) 30 lb	(0.25 ft ³ /kVA) 20 lb
Weight	(83.3 lb/kVA)	(40 lb/kVA)	(40 lb/kVA)	(20 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	2%	2%	2%	
Environment	-17 to 140°F	-17 to 140°F	-17 to 140°F	-65 to 160°F 55,000 ft

Table 5. (Continued).

FREQUENCY CHANGER
0 < P ≤ 5kW

Company	TOPAZ POWERMARK DIV.	Nova Electric	Nova Electric	Brown Boveri Cie
Model	2639			
Rating	\$9290 (\$1.86/vA)	FC5KXX	FC5K3/X	TWK01551
Input	5.0kVA	5kVA	5kVA	1.5kVA
Output	208 or 240 VAC 3 phase, 60 Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	220VAC, 1 phase 50 or 60Hz
Size	230 VAC, 1 phase, 60 Hz 21 x 19 x 21H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 24 x 17 x 33 1/2H	115 or 220 or 240VAC 3 phase, 50 or 60 or 400 24 x 17 x 54 1/2H	20 to 220VAC, 3 phase 2.5 to 120Hz 130 x 240 x 300H mm
Weight	(0.97 ft ³ /kVA) 325 lb	(1.58 ft ³ /kVA) 177 lb	(2.57 ft ³ /kVA) 505 lb	(0.22 ft ³ /kVA) 4.6 kg
Voltage Reg	(65 lb/kVA) 2%	(35.4 lb/kVA) 1%	(101 lb/kVA) 1%	(6.76 lb/kVA)
Frequency Regulation	0.5%	0.15%	0.15%	
Harmonic Distortion	5%	4%	4%	
Environment	0 to 55°C 0 to 90%RH X denotes output frequency	-20 to 50°C	-20 to 50°C	-10 to 40°C

FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	California Instruments	California Instruments
Model	TWK 02551	TWK 03551	503T	1503T
Rating	2.5kVA	3.5kVA	0.5 kVA	1.5 kVA
Input	220VAC, 1 phase 50 or 60Hz	220VAC, 1 phase 50 or 60Hz	115 or 208 or 220 or 230 or 240 VAC 1 phase, 48 to 65 Hz	208 or 220 or 230 or 370 or 416 or 440 or 460 VAC, 3 phase 48 to 65 Hz
Output	20 to 220VAC, 3 phase 2.5 to 120Hz	20 to 220VAC, 3 phase 2.5 to 120Hz	0 to 52 or 0 to 78 or 0 to 130 or 0 to 234 VAC 3 phase, 45 to 10000 Hz	0 to 130 or 0 to 234 VAC 45 to 5000 Hz
Size	165 x 240 x 300H mm (0.168 ft ³ /kVA)	180 x 300 x 340H mm (0.185 ft ³ /kVA)	21 x 19 x 8 3/4H (4.04 ft ³ /kVA)	21 x 19 x 14H (2.16 ft ³ /kVA)
Weight	5.3 kg (4.67 lb/kVA)	8.8 kg (5.54 lb/kVA)	100 lb (220 lb/kVA)	200 lb (133 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion			0.9%	0.9%
Environment	-10 to 40°C	-10 to 40°C	-55 to 71°C	-55 to 71°C

FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.
Model	2561	2630	2631	2736
Rating	\$9125 (\$1.82/VA)	\$6630 (\$3.32/VA)	\$6630 (\$3.32/VA)	\$9855 (\$2.46/VA)
Input	5.0kVA	2.0kVA	2.0kVA	4.0kVA
Output	115 or 230 VAC, 60 Hz	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 50 Hz
Size	230 VAC, 60 Hz 21 x 19 x 21H (0.97 ft ³ /kVA)	115 VAC, 1 phase, 50 Hz 21 x 19 x 14H (1 ft ³ /kVA)	230 VAC, 1 phase, 50 Hz 21 x 19 x 14H (1 ft ³ /kVA)	115 VAC, 1 phase, 50 Hz 21 x 19 x 21H (1.21 ft ³ /kVA)
Weight	325 lb (65 lb/kVA)	240 lb (120 lb/kVA)	240 lb (120 lb/kVA)	325 lb (81.2 lb/kVA)
Voltage Reg	2%	2%	2%	2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.
Model	2643-23	1644	2634	1648-23
Rating	\$9855 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$9290 (\$1.86/VA)
Input	4.0kVA	2.5kVA	2.5kVA	5.0kVA
Output	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 60 Hz	208 or 240 VAC 3 phase, 60 Hz	208 or 240 VAC 3 phase, 60 Hz
Size	230 VAC, 1 phase, 50 Hz 21 x 19 x 21H	115 VAC, 1 phase, 60 Hz 21 x 19 x 14H	230 VAC, 1 phase, 60 Hz 21 x 19 x 14H	115 VAC, 1 phase, 60 Hz 21 x 19 x 21H
Weight	(1.21 ft ³ /kVA) 325 lb	(1.29 ft ³ /kVA) 240 lb	(1.29 ft ³ /kVA) 240 lb	(0.97 ft ³ /kVA) 325 lb
Voltage Reg	(81 lb/kVA) 2%	(96 lb/kVA) 2%	(96 lb/kVA) 2%	(65 lb/kVA) 2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

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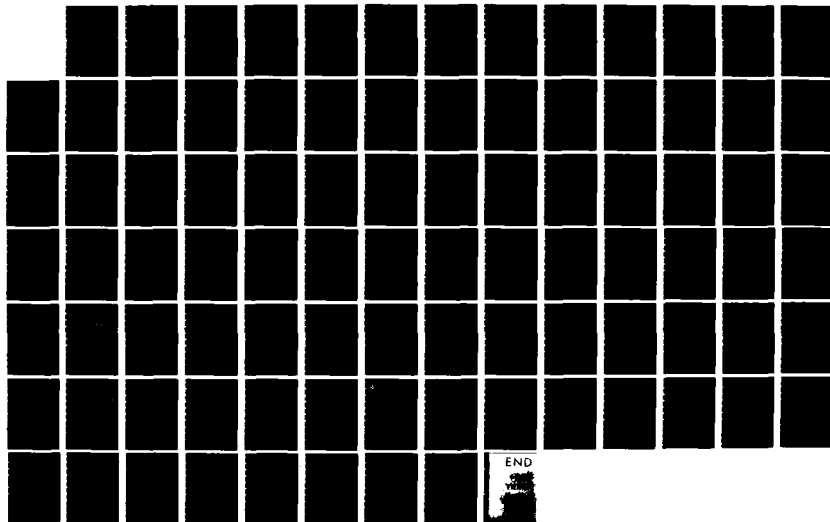
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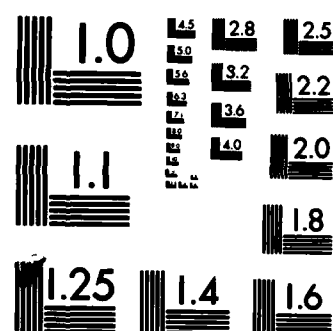
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FREQUENCY CHANGER
0 < P ≤ 5kW

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.
Model	2735	1643-23	2591-23	1647-23
Rating	\$9855 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$9290 (\$1.86/VA)
Input	4.0kVA	2.5kVA	2.5kVA	5.0kVA
Output	115 or 230 VAC, 50 Hz	115 or 230 VAC, 60 Hz	115 or 230 VAC, 60 Hz	115 or 230 VAC, 60 Hz
Size	115 VAC, 50 Hz 21 x 19 x 21H	115 VAC, 60 Hz 21 x 19 x 14H	230 VAC, 60 Hz 21 x 19 x 14H	115 VAC, 60 Hz 21 x 19 x 21H
Weight	(1.21 ft ³ /kVA) 325 lb	(1.29 ft ³ /kVA) 240 lb	(1.29 ft ³ /kVA) 240 lb	(0.97 ft ³ /kVA) 325 lb
Voltage Reg	(81 lb/kVA) 2%	(96 lb/kVA) 2%	(96 lb/kVA) 2%	(65 lb/kVA) 2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

FREQUENCY CHANGERS
5 < P ≤ 15kW

Table 5. (Continued).

Company	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics
Model	SMG 7.5-51	SMG 7.5-53	SMG 15-401	SMG 15-403
Rating	6kW	6kW	12kW	12kW
Input	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz
Output				
Size	120v, 1 phase, 50/60Hz 25 x 17 x 24.5H (0.8 ft ³ /kVA)	120/208 or 277/480v 50/60Hz 25 x 17 x 24.5H (0.8 ft ³ /kVA)	120v, 1 phase, 400Hz 21.5 x 17 x 17.5H (0.25 ft ³ /kVA)	120/208 or 120vΔ, 450vΔ, 400Hz 21.5 x 17 x 17.5H (0.25 ft ³ /kVA)
Weight	520 (600 parallelable) lb (96 lb/kVA)	550 (630 parallelable) lb (73 lb/kVA)	265 (285 parallelable) lb (18 lb/kVA)	280 (310 parallelable) lb (19 lb/kVA)
Voltage Reg	1%	1%	0.5%	0.5%
Frequency Regulation	0.01%	0.01%	.01%	.01%
Harmonic Distortion	2% (output)	2% (output)	1% (output)	1% (output)
Environment	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing

FREQUENCY CHANGERS
5 < P ≤ 15kW

Table 5. (Continued).

Company	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics	Bogue
Model				
Rating	SMG 15-51	SMG 15-53	SMG 15M	8171 (MG Set)
Input	12kW	12kW	12.5kW	10kW, 12.5kVA
Output	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v, 45-65Hz	
Size	120/240v, 10 50/60Hz 25 x 17 x 45.5H (0.744 ft ³ /kVA)	120/208 or 277/480v 50/60Hz 25 x 17 x 45.5H (0.75 ft ³ /kVA)	120/208v, 400Hz	
Weight	790 (850 parallelable) lb (53 lb/kVA)	850 (910 parallelable) lb (57 lb/kVA)		1000 lb (80 lb/kVA)
Voltage Reg	1%		1%	1%
Frequency Regulation	0.01%	0.01%	0.01%	1%
Harmonic Distortion	2% (output)	2% (output)	2% (output) 10% (input)	2% (output)
Environment	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	-34 to 53°C 90%RH 0-8,000ft elevation Outdoor enclosure	

FREQUENCY CHANGER
5 < P ≤ 15kW

Table 5. (Continued).

Company	Georator Corp 37-227 (MG Set)	Georator Corp 37-312 (MG Set)	Georator Corp 37-135 (MG Set)	Georator Corp 37-285 (MG Set)
Model	\$6000 (\$0.96/VA)	\$6000 (\$0.96/VA)	\$6800 (\$0.54/VA)	\$6800 (\$0.54/VA)
Rating	6.25 kVA	6.25 kVA	12.5 kVA	12.5 kVA
Input	220 or 440 VAC 3 phase, 60 Hz	220 or 440 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz
Output	115 or 230 VAC, 60 Hz 48 x 20 x 30H	120 or 208 VAC, 60 Hz 48 x 20 x 30H	120 or 208 VAC, 60 Hz 62 x 22 x 30H	115 or 230 VAC, 60 Hz 62 x 22 x 30H
Size	(2.67 ft ³ /kVA)	(2.67 ft ³ /kVA)	(1.89 ft ³ /kVA)	(1.89 ft ³ /kVA)
Weight	700 lb	700 lb	950 lb	950 lb
Voltage Reg	(112 lb/kVA)	(112 lb/kVA)	(76 lb/kVA)	76 lb/kVA
Frequency Regulation	1%	1%	1%	1%
Harmonic Distortion	5%	5%	5%	5%
Environment	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft

FREQUENCY CHANGERS
5 < P ≤ 15kW

Table 5. (Continued).

Company	Bogue	DEOC	Powertronic Systems	Teledyne Inet
Model				
Rating	8116 (MG Set)	61258		REG 64-007 (MG Set)
Input	15kW, 18.75kVA	10kVA	15kVA	7.5kW, 9.38kVA
Output		115/200v, 3 phase 47-63Hz	480VAC, 3 phase, 60Hz	480v 3 wire 60Hz
Size		115v, 1 phase, 60Hz 24 x 74 x 60H	480VAC, 3 phase, 60Hz 24 x 30 x 21H	200v 4 wire 400Hz 39 x 40 x 56H
Weight	1400 lb	(6.2 ft ³ /kVA)	(0.58 ft ³ /kVA)	(5.4 ft ³ /kVA)
Voltage Reg	(75 lb/kVA)	700 lb	150 lb	1700 lb
Frequency Regulation	1%	(70 lb/kVA)	(10 lb/kVA)	(181 lb/kVA)
Harmonic Distortion	2% (output)	5% (output)	3% (output) 1% (input)	0.5%
Environment				Synchronous with input frequency
				1.5% (Output)
				0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation

FREQUENCY CHANGERS
5 < P ≤ 15kW

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 64-010 (MG Set)	RHG 64-015 (MG Set)	RHG 65-010 (MG Set)	RHG 65-015 (MG Set)
Rating	10kW, 12.5kVA	15kW, 18.75kVA	10kW, 12.5kVA	15kW, 18.75kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Output				
Size	200v 4 wire 400Hz 39 x 40 x 56H (4 ft ³ /kVA)	200v 4 wire 400Hz 39 x 40 x 56H (2.7 ft ³ /kVA)	200v 4 wire 400Hz 44 x 63 x 70H (9 ft ³ /kVA)	200v 4 wire 400Hz 44 x 63 x 70H (6 ft ³ /kVA)
Weight	1700 lb (136 lb/kVA)	1700 lb (91 lb/kVA)	3250 lb (200 lb/kVA)	3325 lb (177 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation

Table 5. (Continued).

FREQUENCY CHANGERS
5 < P ≤ 15kW

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Unitron
Model	REG 66-007 (MG Set)	REG 66-010 (MG Set)	REG 66-015 (MG Set)	CR-074-3
Rating	7.5kW, 9.38kVA	10kW, 12.5kVA	15kW, 18.75kVA	\$9000 (\$3.60/vA)
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	7.5kVA
Output	200v 4 wire 400Hz 39 x 40 x 56H	200v 4 wire 400Hz 39 x 40 x 56H	200v 4 wire 400Hz 39 x 40 x 56H	120/208v, 50/60Hz
Size	(5.3 ft ³ /kVA) 1700 lb	(4 ft ³ /kVA) 1700 lb	(2.7 ft ³ /kVA) 1700 lb	24 x 19 x 17.5H
Weight	(181 lb/kVA) 0.5%	(136 lb/kVA) 0.5%	(91 lb/kVA) 0.5%	(0.62 ft ³ /kVA) 255 lb
Voltage Reg	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	(34 lb/kVA) 120/208 +2%
Frequency Regulation	1.5% (output)	1.5% (output)	1.5% (output)	400 +2Hz
Harmonic Distortion	0% to 50% 10% to 95%RH 0 to 3,300 ft elevation	0% to 50% 10% to 95%RH 0 to 3,300 ft elevation	0% to 50% 10% to 95%RH 0 to 3,300 ft elevation	2.0% (output)
Environment				

FREQUENCY CHANGERS
5 < P ≤ 15kW

Table 5. (Continued).

Company	Unitron	Unitron	Unitron	Unitron
Model	FR-61-33D	CR-104-3	CR-124-3	CR-154-3
Rating	0.0kVA	10.0kVA	12.5kVA	\$16000 (\$1.07/kVA)
Input	115/200V, 400Hz	120/208V, 50/60Hz	120/208V, 50/60Hz	120/208V, 50/60Hz
Output	115V, 60Hz	120/208V, 400Hz 25 x 19 x 31.5H	120/208V, 400Hz 25 x 19 x 31.5H	120/208V, 400Hz 25 x 19 x 31.5H
Size	210 lb	(0.87 ft ³ /kVA) 450 lb	(0.7 ft ³ /kVA) 450 lb	(0.58 ft ³ /kVA) 450 lb
Weight	210 lb	(45 lb/kVA) +2%	(36 lb/kVA) +2%	(30 lb/kVA) +2%
Voltage Reg	+3.0 V RMS	400 +2Hz	400 +2Hz	400 +2Hz
Frequency Regulation	±0.6Hz	2.0% (output)	2.0% (output)	2.0% (output)
Harmonic Distortion	5% (output)			
Environment				

FREQUENCY CHANGERS
5 < P ≤ 15kW

Table 5. (Continued).

Company	Varo	Nova Electric	Nova Electric	Nova Electric
Model	44--	FC10K3/X	FC7.5K3/X	FC10KXX
Rating	10kW	10kVA	7.5kVA	10kVA
Input	440v, 3 phase 3 wire 60Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz
Output	450v, 3 phase 3 wire 400Hz	120 or 208VAC, 3 phase 50 or 60 or 400Hz 24 x 17 x 54 1/2H	120 or 208VAC, 3 phase 50 or 60 or 400Hz 24 x 34 x 42 1/2H	115 or 220 or 240VAC 1 phase 50 or 60 or 400Hz 30 x 22 x 48H
Size		(1.29 ft ³ /kVA) 1350 lb	(2.68 ft ³ /kVA) 785 lb	(1.83 ft ³ /kVA) 675 lb
Weight		(135 lb/kVA)	(105 lb/kVA)	(67.5 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation		0.15%	0.15%	0.15%
Harmonic Distortion	2.5%	4%	4%	4%
Environment				
X denotes output frequency				-20 to 50°C

FREQUENCY CHANGERS
5 < 15kW

Table 5. (Continued).

Company	Ruth & Root Company	Nova Electric	Delco Electronics	Topaz Powermark Div
Model				
Rating	MD2 (MG Set)	FC15K3/X		2720
Input	15kW	15kVA	12kW	10kVA
Output	220 or 440VAC, 3 phase, 60Hz	115 or 220 or 240VAC 48 to 440Hz	120 or 208VAC 3 phase, 50 or 60Hz	208 or 240VAC 3 phase, 60Hz
Size	120 or 208VAC, 3 phase, 400Hz 53 x 39 1/4 x 33H	120 or 208VAC, 3 phase 50 or 60 or 400Hz 24 x 34 x 42 1/2H	120 or 208VAC 3 phase, 400Hz	230VAC, 1 phase, 60Hz 31 x 23 1/4 x 62H
Weight	(2.65 ft ³ /kVA) 1625 lb	(1.34 ft ³ /kVA) 1055 lb	200 lb	(2.59 ft ³ /kVA) 850 lb
Voltage Reg	(108.3 lb/kVA)	(70.3 lb/kVA)	(16.7 lb/kVA)	(85 lb/kVA)
Frequency Regulation		1%		2%
Harmonic Distortion		0.15%		0.5%
Environment		4%		5%
	-40 to 55°C	-20 to 55°C	125°F	0 to 55°C 95°F RH

X denotes output frequency

FREQUENCY CHANGER
5 < P ≤ 15kW

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV. 2697	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	\$18475 (\$1.85/vA)	TWK 05553	TWK 11053	RWK 00831
Rating	10.0kVA	5.5kVA	11kVA	8.5kVA
Input	208 or 240 VAC 3 phase, 60 Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Output	115 VAC, 1 phase, 60 Hz 31 x 23 1/4 x 62H	35 to 380VAC, 3 phase 2.5 to 120Hz 235 x 300 x 370H mm	35 to 380VAC, 3 phase 2.5 to 120Hz 235 x 320 x 450H mm	30 to 360VAC, 3 phase 5 to 150Hz 360 x 483 x 525H mm
Size	(2.59 ft ³ /kVA) 850 lb	(0.167 ft ³ /kVA) 13 kg	(0.109 ft ³ /kVA) 23 kg	(0.379 ft ³ /kVA) 65 kg
Weight	(85 lb/kVA)	(5.21 lb/kVA)	(4.61 lb/kVA)	(16.86 lb/kVA)
Voltage Reg	2%			
Frequency Regulation	0.5%			
Harmonic Distortion	5%			
Environment	0 to 55°C 0 to 90%RH	-10 to 40°C	-10 to 40°C	-10 to 40°C

FREQUENCY CHANGER
5 < P ≤ 15kW

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV. 2732	TOPAZ POWERMARK DIV. 2707	TOPAZ POWERMARK DIV. 2731	TOPAZ POWERMARK DIV. 2771
Model	\$19955 (\$2.49/VA)	\$18475 (\$1.85/VA)	\$19955 (\$2.49/VA)	\$19955 (\$2.49/VA)
Rating	8.0kVA	10.0kVA	8.0kVA	8.0kVA
Input	230 VAC, 50 Hz	230 VAC, 60 Hz	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 50 Hz
Output	115 or 230 VAC, 50 Hz 31 x 23 1/4 x 62H	115 or 230 VAC, 60 Hz 31 x 23 1/4 x 62H	115 VAC, 1 phase, 50 Hz 31 x 23 1/4 x 62H	230 VAC, 1 phase, 50 Hz 31 x 23 1/4 x 62H
Size	(3.23 ft ³ /kVA) 850 lb	(2.59 ft ³ /kVA) 850 lb	(3.23 ft ³ /kVA) 850 lb	(3.23 ft ³ /kVA) 850 lb
Weight	(106 lb/kVA)	(85 lb/kVA)	(106 lb/kVA)	(106 lb/kVA)
Voltage Reg	2%	2%	2%	2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

Table 5. (Continued).

FREQUENCY CHANGER
 $5 < P \leq 15 \text{ kW}$

Company	California Instruments			
Model	15KT1			
Rating	15 kVA			
Input	208 VAC, 3 phase 48 to 65 Hz			
Output	0 to 130 or 0 to 260 VAC 45 to 2000 Hz			
Size	32 1/2 x 28 3/8 x 79 3/4 (2.82 ft ³ /kVA)			
Weight	1500 lb (100 lb/kVA)			
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	0.5%			
Environment	0 to 55°C			

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	ABEX-JETWAY	ABEX-JETWAY	ABEX-JETWAY	Nova Electric
Model			60	
Rating	30	40	\$50000 (\$0.83/VA)	FC30K3/X
Input	30kVA	40kVA	60kVA	30kVA
Output	230V to 600V 30 50-60Hz	208 to 600V 30 50-60Hz	230-600VAC 30, 50-60Hz	115 or 220 or 240VAC 48 to 440Hz
Size	116/200V 3 phase, 400Hz 64 x 54 x 16H	116/200V 3 phase, 400Hz 64 x 54 x 16H	115/200 VAC 3 phase, 400Hz 64 x 54 x 16H	120 or 208VAC, 3 phase 50 or 60 or 400Hz 30 x 44 x 64H
Weight	(1.07 ft ³ /kVA) 1400 lb	(0.8 ft ³ /kVA) 1500 lb	(0.533 ft ³ /kVA) 1500 lb	(1.63 ft ³ /kVA) 2050 lb
Voltage reg	+3%	(37.5 lb/kVA) +3%	(25 lb/kVA) +3%	(68.3 lb/kVA) 1%
Frequency Regulation	+0.04%	+0.04%	+0.04%	0.15%
Harmonic Distortion	5%	5%	5%	4%
Environment	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl	-20 to 50°C

X denotes output frequency

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics
Model	SMG 30-51	SMG 30-53	SMG 30-401	SMG 30-403
Rating	24kW	24kW	24kW	24kW
Input	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz
Output				
Size	120/240v, 1 phase 50/60Hz 36 x 24 x 72H	120/208v or 277/480v 50/60Hz 36 x 24 x 72H	120/208v and/or 120 or 450 31.5 x 17 x 31.5H	120/208v or 120A or 450Δ 31.5 x 17 x 31.5H
Weight	(1.2 ft ³ /kVA) 1110 (1225 parallelable) 1b (37 lb/kVA)	(1.2 ft ³ /kVA) 1200 (1330 parallelable) 1b (40 lb/kVA)	(0.33 ft ³ /kVA) 435 (475 parallelable) 1b (14.5 lb/kVA)	(0.33 ft ³ /kVA) 480 (530 parallelable) 1b (16.1 lb/kVA)
Voltage Reg	1%	1%	0.5%	0.5%
Frequency Regulation	0.01%	0.01%	0.01%	0.01%
Harmonic Distortion	2% (output)	2% (output)	1% (output)	1% (output)
Environment	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Bogue	Bogue	Bogue	Bogue
Model				50KVA FCT (rotating transformer) \$18700 (\$0.37/vA)
Rating	MD 3-7670 (MG Set)	MC 1A 7781 (MG Set)		7589 (MG Set)
Input	20kW	30kW		30kW, 37.5KVA
Output	60Hz	60Hz		380v, 2 phase, 50Hz
Size	400Hz	400Hz		480v, 3 phase, 60Hz 39 1/4 x 28 x 67H (0.85 ft ³ /KVA) 2800 lb (56 lb/KVA)
Weight				1,800 lb 1%
Voltage Reg				1%
Frequency Regulation				1%
Harmonic Distortion				2% (output)
Environment				

FREQUENCY CHANGER
15 < P ≤ 60kW

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	RWK 01631	RWK 02531	RWK 03831	RWK 05631
Rating	16kVA	25kVA	38kVA	56kVA
Input	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Output	30 to 360VAC, 3 phase 5 to 150Hz	30 to 360VAC, 3 phase 5 to 150Hz	30 to 360VAC, 3 phase 5 to 150Hz	30 to 360VAC, 3 phase 5 to 150Hz
Size	300 x 550 x 1250H mm (0.455 ft ³ /kVA)	300 x 550 x 1250H mm (0.291 ft ³ /kVA)	600 x 600 x 2200H mm (0.736 ft ³ /kVA)	600 x 600 x 2200H mm (0.499 ft ³ /kVA)
Weight	125 kg (17.2 lb/kVA)	140 kg (12.3 lb/kVA)	252 kg (14.6 lb/kVA)	350 kg (13.8 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C

FREQUENCY CHANGER
15 < P ≤ 60kW

Table 5. (Continued).

Company	Georator Corp 37-136 (MG Set)	Georator Corp 37-137 (MG Set)	Georator Corp 37-139 (MG Set)	Georator Corp 37-138 (MG Set)
Model	\$7200 (\$0.38/va)	\$7200 (\$0.38/va)	\$8000 (\$0.32/va)	\$8000 (\$0.32/va)
Rating	18.75 kVA	18.75 kVA	25 kVA	25 kVA
Input	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz
Output				
Size	120 or 208 VAC, 60 Hz 64 x 22 x 38H (1.65 ft ³ /kVA)	115 or 230 VAC, 60 Hz 70 x 22 x 30H (1.43 ft ³ /kVA)	115 or 230 VAC, 60 Hz 72 x 24 x 38H (1.52 ft ³ /kVA)	120 or 208 VAC, 60 Hz 65 x 24 x 38H (1.37 ft ³ /kVA)
Weight	1200 lb (64 lb/kVA)	1300 lb (69.3 lb/kVA)	1550 lb (62 lb/kVA)	1300 lb (52 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation				
Harmonic Distortion	5%	5%	5%	5%
Environment	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Bogue	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	PP60 (MG Set)	REG 64-020 (MG Set)	REG 64-030 (MG Set)	REG 64-036 (MG Set)
Input	60kW, 75kVA	20kW, 25kVA	30kW, 37.5kVA	36kW, 45kVA
Output		480v 3 wire 60Hz	480v 3 wire 60Hz	208v, 60Hz
Size		200v 4 wire 400Hz 39 x 40 x 56H	200v 4 wire 400Hz 39 x 44 x 56H	120/208v, 400Hz 33 x 51 x 54H
Weight	4500 lb	(2 ft ³ /kVA) 1700 lb	(1.5 ft ³ /kVA) 1900 lb	(1.2 ft ³ /kVA) 2700 lb
Voltage Reg	1%	(60 lb/kVA) 0.5%	(63 lb/kVA) 0.5%	(60 lb/kVA) 0.5%
Frequency Regulation	1%	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	2% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment		0-50°C 10% to 95%RH 0 to 3,300 ft elevation	0-50°C 10% to 95%RH 0 to 3,300 ft elevation	-40°C to 50°C 0% to 100%RH 0 to 3,300 ft elevation Outdoor enclosure

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	REG 64-040 (MG Set)		REG 64-060 (MG Set)	REG 66-020 (MG Set)
Rating				
Input	40kW, 50kVA		60kW, 75kVA	20kW, 25kVA
Output	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Size	200v 4 wire 400Hz 45 x 47 x 68H (1.7 ft ³ /kVA)	200v 4 wire 400Hz 45 x 47 x 68H (1.1 ft ³ /kVA)	200v 4 wire 400Hz 39 x 40 x 56H (2 ft ³ /kVA)	200v 4 wire 400Hz 39 x 40 x 56H (1.3 ft ³ /kVA)
Weight	2500 lb (50 lb/kVA)	2800 lb (37 lb/kVA)	1700 lb (68 lb/kVA)	1700 lb (45 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0-50°C 10% to 95%RH 0 to 3,300 ft elevation	0-50°C 10% to 95%RH 0 to 3,300 ft elevation	0-50°C 10% to 95%RH 0 to 3,300 ft elevation	0-50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 66-040 (MG Set)	MMG 1A (MG Set)	MD-4 (MG Set)	RHG 66-060 (MG Set)
Rating	40kW, 50kVA	48kW, 60kVA	48kW, 60kVA	60kW, 75kVA
Input	480v 3 wire 60Hz			480v 3 wire 60Hz
Output		220/440v, 60Hz	120/208, 3 phase, 60Hz	
Size	200v 4 wire 400Hz 39 x 44 x 56H (1.1 ft ³ /kVA) 1900 lb	115/200, 28VDC 400Hz 85 x 49 x 41H (1.65 ft ³ /kVA) 4120 lb	WYE 208 L/L, 120 L/N Delta, 120 L/L 400Hz 96 x 45 x 40H (1.67 ft ³ /kVA) 3500 lb	200v 4 wire 400Hz 45 x 47 x 68H (1.1 ft ³ /kVA) 2500 lb
Weight	(38 lb/kVA) 0.5%	(69 lb/kVA) 0.5%	(58 lb/kVA) 1.0%	(33 lb/kVA) 0.5%
Voltage Reg	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Frequency Regulation	1.5% (output)	1.5% (output)	2.0% (output)	1.5% (output)
Harmonic Distortion	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	-40°C to 50°C 0% to 100%RH 0 to 3,300 ft elevation	-46°C to 55°C 0% to 100%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation
Environment				

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHM 64-060 (MG Set)	RVG 66-060 (MG Set)	RHG 65-020 (MG Set)	RHG 65-025 (MG Set)
Rating	60kW, 75kVA	60kW, 75kVA	20kW, 25kVA	25kW, 31.25kVA
Input	480/380v 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Output				
Size	245/425v, 400Hz 49 x 54 x 47H	200v 4 wire 400Hz 56 x 40 x 80H	200v 4 wire 400Hz 44 x 63 x 70H	200v 4 wire 400Hz 44 x 63 x 70H
Weight	(0.96 ft ³ /kVA) 4325 lb	(1.38 ft ³ /kVA) 3200 lb	(4.49 ft ³ /kVA) 3400 lb	(3.59 ft ³ /kVA) 3500 lb
Voltage Reg	(57.7 lb/kVA) 0.5%	(42.7 lb/kVA) 0.5%	(136 lb/kVA) 0.5%	(112 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.0% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	-40°C to 52°C 0% to 100%RH 0 to 10,000 ft elevation Outdoor enclosure	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	REG 65-030 (MG Set)	REG 65-040 (MG Set)	REG 65-060 (MG Set)	REG 64-020 (MG Set)
Rating	30kW, 37.5kVA	40kW, 50kW	60kW, 75kVA	20kW, 25kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Output	200v 4 wire 400Hz 44 x 63 x 70H (2.99 ft ³ /kVA) 3750 lb (100 lb/kVA)	200v 4 wire 400Hz 50 x 75 x 70H (3.04 ft ³ /kVA) 4000 lb (80 lb/kVA)	200v 4 wire 400Hz 50 x 75 x 70H (2.03 ft ³ /kVA) 5000 lb (66.7 lb/kVA)	200v 4 wire 400Hz 56 x 40 x 80H (4.15 ft ³ /kVA) 3700 lb (148 lb/kVA)
Size				
Weight				
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Unitron
Model	RVG 64-030 (MG Set)	RVG 64-040 (MG Set)	RVG 64-060 (MG Set)	GFC-40
Rating	30kW, 37.5kVA	40kW, 50kVA	60kW, 75kVA	40.0kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	460v, 50/60Hz
Output				
Size	200v 4 wire 400Hz 56 x 40 x 80H	200v 4 wire 400Hz 56 x 40 x 80H	200v 4 wire 400Hz 56 x 40 x 80H	120/208v, 400Hz 12 x 41 x 42H
Weight	(2.8 ft ³ /kVA) 3800 lb (101 lb/kVA)	(2.1 ft ³ /kVA) 3900 lb (78 lb/kVA)	(1.4 ft ³ /kVA) 4100 lb (55 lb/kVA)	(0.3 ft ³ /kVA) 500 lb (12 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	120/208 ±0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	2% (output)
Environment	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	Environmentally secure

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	Varo	Varo	Varo	Varo	Nova Electric
Model	44--	44--	44--	44--	FC20K3/X
Rating	16kW	25kW	40kW	40kW	20kVA
Input	440v, 3 phase 3 wire 60Hz	440v, 3 phase 3 wire 60Hz	440v, 3 phase 3 wire 60Hz	440v, 3 phase 3 wire 60Hz	115 or 220 or 240VAC 48 to 440Hz
Output	450v, 3 phase 3 wire 400Hz	450v, 3 phase 3 wire 400Hz	450v, 3 phase 3 wire 400Hz	450v, 3 phase 3 wire 400Hz	120 or 208VAC, 3 phase 50 or 60 or 400Hz
Size					30 x 44 x 64H (2.44 ft ³ /kVA) 1500 lb
Weight					(75 lb/kVA) 1%
Voltage Reg	1%	1%	1%	1%	1%
Frequency Regulation					0.15%
Harmonic Distortion	2.5% (output)	2.5% (output)	2.5% (output)	2.5% (output)	4%
Environment					-20 to 50°C

X denotes output frequency

FREQUENCY CHANGERS
15 < P ≤ 60kW

Table 5. (Continued).

Company	CTS of Canada	Kurz & Root Company	Kurz & Root Company	Kurz & Root Company
Model				
Rating	8050	MC 1A (MG Set)	MD3 (MG Set)	MD4 (MG Set)
Input	40kVA	30kW	30kW	60kW
Output	120 or 208 or 600VAC, 50 or 60Hz	220 or 440VAC, 3 phase, 60Hz	220 or 440VAC, 3 phase, 60Hz	220 or 440VAC, 3 phase, 60Hz
Size	Various 3 phase, 50 or 60 or 400Hz	120 or 208VAC, 3 phase, 400Hz 108 x 50 1/2 x 40H	120 or 208VAC, 3 phase, 400Hz 65 x 41 x 36 1/2H	120 or 208VAC, 3 phase, 400Hz 72 1/2 x 36 1/4 x 41H
Weight		(4.21 ft ³ /kVA) 4100 lb	(1.88 ft ³ /kVA) 2650 lb	(1.04 ft ³ /kVA) 3680 lb
Voltage Reg	2%	(136.7 lb/kVA)	(88.3 lb/kVA)	(61.3 lb/kVA)
Frequency Regulation	0.01%			
Harmonic Distortion	3 to 5%			
Environment	32 to 132°F 95%RH 10,000 ft	-40 to 55°C	-40 to 55°C	-40 to 55°C

FREQUENCY CHANGER
15 < P < 60kW

Table 5. (Continued).

Company	Bendix Corp	Brown Boveri Cie	Brown Boveri Cie
Model			
Rating	38B67-2	TWK 22053	TWK 33053
Input	20 kVA	22kVA	33kVA
Output	400 to 550 VAC 3 phase, 400 Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Size	120 VAC, 1 phase, 60 Hz 450 VAC, 3 phase, 60 Hz 23.4 x 20.8 x 25.2H	35 to 380VAC, 3 phase 5 to 87Hz 375 x 440 x 870H mm	35 to 380VAC, 3 phase 5 to 87Hz 375 x 440 x 870H mm
Weight	(0.355 ft ³ /kVA) 418 lb	(0.23 ft ³ /kVA) 60 kg	(0.154 ft ³ /kVA) 60 kg
Voltage Reg	(20.9 lb/kVA)	(6.01 lb/kVA)	(4.01 lb/kVA)
Frequency Regulation	3%		
Harmonic Distortion	3%		
Environment		-10 to 40°C	-10 to 40°C

FREQUENCY CHANGERS
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	ABEX-JETWAY	ABEX-JETWAY	Franklin Electric	CTS of Canada
Model				
Rating	90	120	4125	8350
Input	90kVA	120kVA	125kVA	125kVA
Output	230-600VAC 30, 50-60Hz	230-600VAC 30, 50-60Hz	208 or 380 or 480VAC 50 or 60Hz	120 or 208 or 600VAC 50 or 60Hz
Size	115/200VAC 30, 400Hz 64 x 54 x 16H	115/200VAC 30, 400Hz 64 x 54 x 16H	208VAC, 3 phase 400 or 415 or 441Hz 36 x 72 x 72H	Various 3 phase 50 or 60 or 400Hz
Weight	(0.356 ft ³ /kVA) 1800 lb	(0.267 ft ³ /kVA) 2100 lb	(0.864 ft ³ /kVA) 5000 lb	
Voltage Reg	+3%	(17.5 lb/kVA) +3%	(40 lb/kVA) 1%	2%
Frequency Regulation	+0.04%	+0.04%	0.5%	0.01%
Harmonic Distortion	5%	5%	5%	3 to 5%
Environment	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl	32 to 104°F 95%RH 3300 ft	32 to 132°F 95%RH 10,000 ft

FREQUENCY CHANGERS
60kW < P ≤

Table 5. (Continued).

Company	A.L.S. Electronics	Bogue	Bogue	Bogue
Model		75kVA FCT (rotating transformer) \$20900 (\$0.28/VA)	100kVA FCT (rotating transformer) \$22100 (\$0.72/VA)	Bogue
Rating	Mark 84			8109 (MG Set)
Input	375kVA	75kVA	100kVA	100kW, 125kVA
Output	440v, 60Hz	380v, 3 phase, 50Hz	380v, 3 phase, 50Hz	
Size	440v, 400Hz	480v, 3 phase, 60Hz 39 1/4 x 28 x 67H	480v, 3 phase, 60Hz 39 1/4 x 28 x 67H	
Weight		(0.568 ft ³ /kVA) 3000 lb	(0.426 ft ³ /kVA) 3200 lb	
Voltage Reg	1.063%	(40 lb/kVA)	(32 lb/kVA)	6,500 lb 1%
Frequency Regulation	0.5%			1%
Harmonic Distortion Environment	3% (output)			2% (output)

FREQUENCY CHANGER
60kW < P ≤

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	RWK 09531	RWK 14021	LWA 099	LWA 199
Rating	95kVA	140kVA	99kW	199kW
Input	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz
Output	30 to 360VAC, 3 phase 5 to 150Hz	30 to 360VAC, 3 phase 5 to 87Hz	38-380 or 50-500VAC 3 phase, 5-50Hz	38-380 or 50-500VAC 3 phase, 5-50Hz
Size	600 x 600 x 2200H mm (0.294 ft ³ /kVA)	600 x 800 x 2200H mm (0.266 ft ³ /kVA)	600 x 1000 x 2200H mm (0.471 ft ³ /kVA)	600 x 1000 x 2200H mm (0.234 ft ³ /kVA)
Weight	460 kg (10.7 lb/kVA)	550 kg (8.66 lb/kVA)		
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-10 to 35°C	-10 to 35°C	-10 to 45°C 1000 m	-10 to 45°C 1000 m

FREQUENCY CHANGER
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model				
Rating	SNK 20034	SNK 28034	SNK 38034	SNK 54034
Input	200kVA	280kVA	380kVA	540kVA
Output	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Size	10 to 500VAC, 3 phase 5 to 150Hz 800 x 800 x 2200H mm (0.249 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 800 x 800 x 2200H mm (0.178 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 800 x 1600 x 2200H mm (0.262 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 800 x 1600 x 2200H mm (0.184 ft ³ /kVA)
Weight				
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C

FREQUENCY CHANGER
60kW < P ≤

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	LWA 144	LWA 180	LWA 225	LWA 283
Rating	144kVA	180kVA	225kVA	283kVA
Input	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz
Output	38-380 or 50-500VAC 3 phase, 5-50Hz 600 x 1000 x 2200H mm (0.324 ft ³ /kVA)	38-380 or 50-500VAC 3 phase, 5-50Hz 600 x 1000 x 2200H mm (0.259 ft ³ /kVA)	38-380 or 50-500VAC 3 phase, 5-50Hz 600 x 1000 x 2200H mm (0.207 ft ³ /kVA)	38-380 or 50-500VAC 3 phase, 5-50Hz 600 x 1000 x 2200H mm (0.165 ft ³ /kVA)
Size				
Weight				
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-10 to 45°C 1000 m	-10 to 45°C 1000 m	-10 to 45°C 1000 m	-10 to 45°C 1000 m

FREQUENCY CHANGER
60kW < P ≤

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model				
Rating	SWK 06531	SWK 12031	SWK 17031	SWK 25031
Input	65kVA	120kVA	170kVA	250kVA
Output	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Size	7.5 to 380VAC, 3 phase 5 to 150Hz 600 x 600 x 2200H mm (0.43 ft ³ /kVA)	7.5 to 380VAC, 3 phase 5 to 150Hz 600 x 600 x 2200H mm (0.233 ft ³ /kVA)	7.5 to 380VAC, 3 phase 5 to 150Hz 800 x 800 x 2200H mm (0.292 ft ³ /kVA)	7.5 to 380VAC, 3 phase 5 to 150Hz 800 x 800 x 2200H mm (0.199 ft ³ /kVA)
Weight				
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C

FREQUENCY CHANGER
60kW < P ≤

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model				
Rating	SWK 32031	SWK 45031	SWK 08034	SWK 14534
Input	320kVA	450kVA	80kVA	145kVA
Output	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Size	7.5 to 380VAC, 3 phase 5 to 150Hz 800 x 1600 x 2200H mm (0.311 ft ³ /kVA)	7.5 to 380VAC, 3 phase 5 to 150Hz 800 x 1600 x 2200H mm (0.221 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 600 x 600 x 2200H mm (0.35 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 600 x 600 x 2200H mm (0.193 ft ³ /kVA)
Weight				
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C

FREQUENCY CHANGERS
60kW < P ≤

Table 5. (Continued).

Company	Boque	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model		A/C 63	A/C 72	A/C 110
Rating	7383	\$18500 (\$2.64/VA)	\$18900 (\$2.36/VA)	\$20300 (\$1.66/VA)
Input	200kW	63kW, 70kVA	72kW, 80kVA	110kW, 122kVA
Output	460v, 3 phase, 60Hz	440v, 3 wire, 60Hz	440v, 3 wire, 60Hz	440v, 3 wire, 60Hz
Size	120/208v, 3 phase, 400Hz	450v, 3 wire, 400Hz 72 x 29 x 75H	450v, 3 wire, 400Hz 72 x 29 x 75H	450v, 3 wire, 400Hz 72 x 29 x 75H
Weight		(1.3 ft ³ /kVA) 5500 lb	(1.1 ft ³ /kVA) 5500 lb	(0.75 ft ³ /kVA) 5500 lb
Voltage Reg		(78 lb/kVA) +0.3%	(69 lb/kVA) +0.3%	(45 lb/kVA) +0.3%
Frequency Regulation		+0.025%	+0.025%	+0.025%
Harmonic Distortion		2% (output) 3% (input)	2% (output) 3% (input)	2% (output) 3% (input)
Environment		0 to 50°C, 100%RH 0 to 8000 ft drip-proof		0 to 50°C, 100%RH 8000 ft drip-proof

FREQUENCY CHANGERS
60kW < P ≤

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	A/C 160			
Rating	\$21900 (\$1.23/VA)	RHG 64-075 (MG Set)	RHG 64-100 (MG Set)	RHG 64-125 (MG Set)
Input	160kW, 178kVA	75kW, 93.7kVA	100kW, 125kVA	125kW, 156kVA
Output	440v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Size	450v, 3 wire, 400Hz 72 x 29 x 75H	200v, 4 wire, 400Hz 53 x 50 x 70H	200v, 4 wire, 400Hz 53 x 50 x 70H	200v, 4 wire, 400Hz 53 x 50 x 70H
Weight	(0.51 ft ³ /kVA) 5900 lb	(1.15 ft ³ /kVA) 4200 lb	(4.29 ft ³ /kVA) 4200 lb	(0.688 ft ³ /kVA) 4400 lb
Voltage Reg	(33.1 lb/kVA) +0.3%	(44.8 lb/kVA) 0.5%	(33.6 lb/kVA) 0.5%	(28.2 lb/kVA) 0.5%
Frequency Regulation	+0.025%	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	2% (output) 3% (input)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0 to 50°C, 100%RH 8000 ft drip-proof	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	RHG 65-075 (MG Set)	RHG 65-100 (MG Set)	RHG 65-125 (MG Set)	RHG 65-150 (MG Set)
Input	75kW, 93.75kVA	100kW, 125kVA	125kW, 156kVA	150kW, 188kVA
Output	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Size	250v, 4 wire, 400Hz 50 x 100 x 72H (2.2 ft ³ /kVA)	200v, 4 wire, 400Hz 62 x 194 x 78H (4.3 ft ³ /kVA)	200v, 4 wire, 400Hz 62 x 194 x 78H (3.48 ft ³ /kVA)	200v, 4 wire, 400Hz 62 x 149 x 78H (2.22 ft ³ /kVA)
Weight	5500 lb (59 lb/kVA)	10000 lb (80 lb/kVA)	10100 lb (65 lb/kVA)	10250 lb (55 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	RHG 65-150 (MG Set)	RHG 65-200 (MG Set)	RHG 65-250 (MG Set)	RHG 65-300 (MG Set)
Input	150kW, 188kVA	200kW, 250kVA	250kW, 312.5kVA	300kW, 375kVA
Output	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Size	200v, 4 wire, 400Hz 62 x 149 x 78H	200v, 4 wire, 400Hz 62 x 149 x 78H	200v, 4 wire, 400Hz 62 x 149 x 78H	200v, 4 wire, 400Hz 62 x 149 x 78H
Weight	(2.22 ft ³ /kVA) 10250 lb	(1.67 ft ³ /kVA) 10250 lb	(1.33 ft ³ /kVA) 10750 lb	(1.11 ft ³ /kVA) 11000 lb
Voltage Reg	(54.5 lb/kVA) 0.5%	(41 lb/kVA) 0.5%	(34.4 lb/kVA) 0.5%	(29.3 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	RVD 64-067 (MG Set)	RVG 64-075 (MG Set)	RVG 64-100 (MG Set)	RVG 64-125 (MG Set)
Input	76.5kW, 75kVA	75kW, 93.75kVA	100kW, 125kVA	125kW, 156kVA
Output	480V, 3 wire, 60Hz	480V, 3 wire, 60Hz	480V, 3 wire, 60Hz	480V, 3 wire, 60Hz
Size	250V, 4 wire, 400Hz 56 x 40 x 80H	200V, 4 wire, 400Hz 56 x 40 x 80H	200V, 4 wire, 400Hz 56 x 40 x 80H	200V, 4 wire, 400Hz 56 x 40 x 80H
Weight	(1.38 ft ³ /kVA) 4150 lb	(1.11 ft ³ /kVA) 4250 lb	(0.83 ft ³ /kVA) 4500 lb	(0.66 ft ³ /kVA) 4750 lb
Voltage Reg	(55.3 lb/kVA) 0.5%	(45.3 lb/kVA) 0.5%	(36 lb/kVA) 0.5%	(30.4 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	RVG 64-150 (MG Set)	RVG 64-160 (MG Set)	RVG 64-200 (MG Set)	RVG 64-250 (MG Set)
Input	150kW, 188kVA	160kW, 200kVA	200kW, 250kVA	250kW, 312.75kVA
Output	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Size	250v, 4 wire, 400Hz 56 x 40 x 80H (0.55 ft ³ /kVA)	200v, 4 wire, 400Hz 56 x 40 x 80H (0.52 ft ³ /kVA)	200v, 4 wire, 400Hz 56 x 40 x 80H (0.41 ft ³ /kVA)	200v, 4 wire, 400Hz 56 x 40 x 80H (0.33 ft ³ /kVA)
Weight	4900 lb (26.1 lb/kVA)	5850 lb (29.3 lb/kVA)	6700 lb (26.8 lb/kVA)	7000 lb (22.4 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 66-125 (MG Set)	RHG 66-150 (MG Set)	RHG 66-160 (MG Set)	RVG 66-075 (MG Set)
Rating	125kW, 156kVA	150kW, 188kVA	160kW, 200kVA	75kW, 93.75kVA
Input	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz
Output	200v, 4 wire, 400 Hz 53 x 51 x 70H	200v, 4 wire, 400 Hz 53 x 51 x 70H	200v, 4 wire, 400 Hz 53 x 51 x 70H	200v, 4 wire, 400 Hz 56 x 40 x 80H
Size	(0.7 ft ³ /kVA)	(0.58 ft ³ /kVA)	(0.55 ft ³ /kVA)	(1.11 ft ³ /kVA)
Weight	4200 lb	4400 lb	4400 lb	3350 lb
Voltage Reg	(26.9 lb/kVA)	(23.4 lb/kVA)	(22 lb/kVA)	(35.7 lb/kVA)
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Environment	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	RVG 66-100 (MG Set)	RVG 66-125 (MG Set)	RVG 66-150 (MG Set)	RVG 66-175 (MG Set)
Input	100kW, 125kVA	125kW, 156kVA	150kW, 180kVA	175kW, 218.75kVA
Output	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz
Size	200v, 4 wire, 400 Hz 56 x 40 x 80H	200v, 4 wire, 400 Hz 56 x 40 x 80H	200v, 4 wire, 400 Hz 56 x 40 x 80H	200v, 4 wire, 400 Hz 56 x 40 x 80H
Weight	(0.83 ft ³ /kVA) 3600 lb	(0.66 ft ³ /kVA) 3850 lb	(0.58 ft ³ /kVA) 4000 lb	(0.47 ft ³ /kVA) 5500 lb
Voltage Reg	(28.8 lb/kVA) 0.5%	(24.7 lb/kVA) 0.5%	(22.2 lb/kVA) 0.5%	(25.1 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model				
Rating	RVG 66-200 (MG Set)	RVG 66-250 (MG Set)	RVG 66-300 (MG Set)	RVM 64-250 (MG Set)
Input	200kW, 250kVA	250kW, 312.5kVA	300kW, 375kVA	250kW, 312.5kVA
Output	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz	480v, 3 wire, 60 Hz
Size	200v, 4 wire, 400 Hz 56 x 40 x 80H (0.41 ft ³ /kVA)	200v, 4 wire, 400 Hz 56 x 40 x 80H (0.33 ft ³ /kVA)	200v, 4 wire, 400 Hz 56 x 40 x 80H (0.28 ft ³ /kVA)	200v, 4 wire, 400 Hz 59 x 87 x 87H (0.83 ft ³ /kVA)
Weight	5800 lb (23.2 lb/kVA)	6100 lb (19.5 lb/kVA)	6450 lb (17.2 lb/kVA)	8850 lb (28.3 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	1.0%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft Outdoor Enclosure

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Varo	Varo	Varo	Franklin Electric
Model	4412	44--	44--	475
Rating	63kW	100kW	160kW	75kVA
Input	440v, 30, 3 wire, 60 Hz	440v, 30, 3 wire, 60 Hz	440v, 30, 3 wire, 60 Hz	208 or 380 or 480VAC 50 or 60Hz
Output	450, 30, 3 wire, 400 Hz	450, 30, 3 wire, 400 Hz	450, 30, 3 wire, 400 Hz	208VAC, 3 phase 400 or 415 or 441Hz 36 x 54 x 72H
Size				(1.08 ft ³ /kVA) 3800 lb
Weight				(50.7 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation				0.5%
Harmonic Distortion	2.5% (output)	2.5% (output)	2.5% (output)	5%
Environment				32 to 104°F 95%RH 3300 ft

FREQUENCY CHANGERS
60KW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model			
Rating	RVG 64-250 (MG Set)	RHG 66-075 (MG Set)	RHG 66-100 (MG Set)
Input	250KW, 312.5KVA	75KW, 93.75KVA	100KW, 125KVA
Output	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Size	250v, 4 wire, 400Hz 56 x 40 x 80H (0.33 ft ³ /KVA)	200v, 4 wire, 400Hz 45 x 47 x 68H (0.89 ft ³ /KVA)	200v, 4 wire, 400Hz 53 x 51 x 70H (0.88 ft ³ /KVA)
Weight	7000 lb (22.4 lb/KVA)	2800 lb (29.9 lb/KVA)	4200 lb (33.6 lb/KVA)
Voltage Reg	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

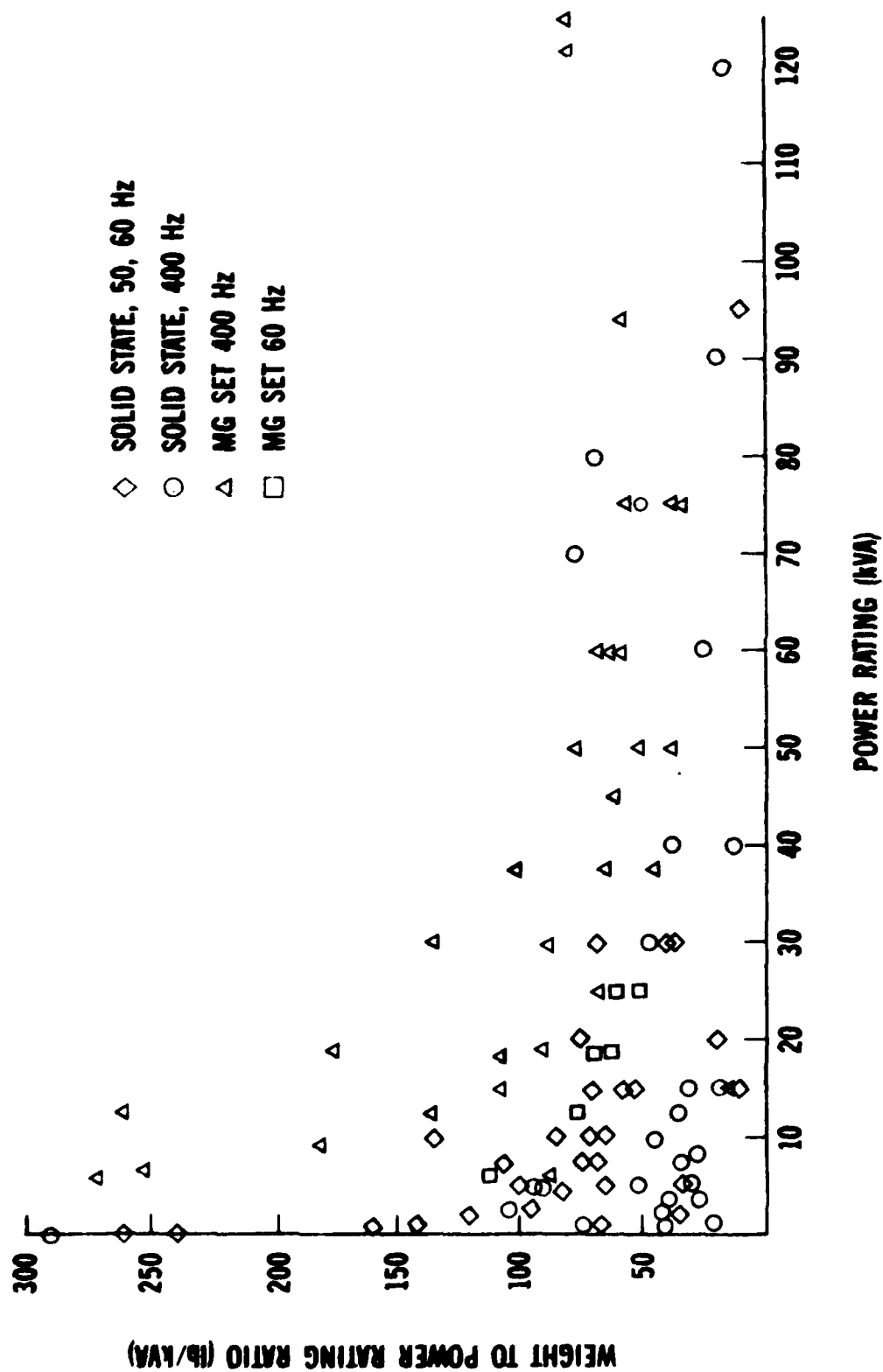


Figure 3. Weight to power rating ratio of frequency changers vs power rating.

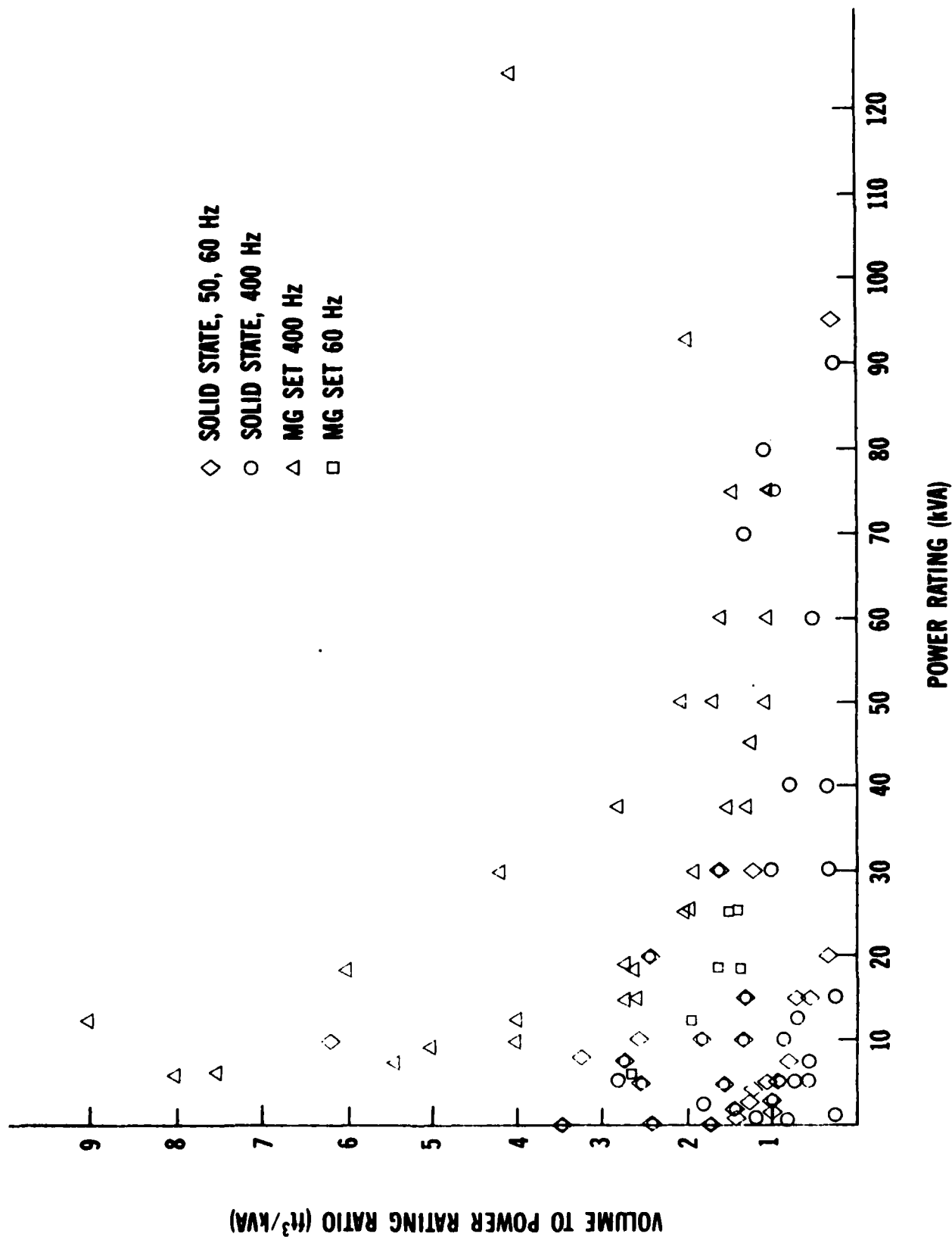


Figure 4. Volume to power rating ratio for frequency changers vs power rating.

In the power range from 5 kW to 15 kW, one unit from A.L.S. Corp. (Model SMG-15M) is built to military specifications with an operating temperature range of -34 to $+53^{\circ}\text{C}$. Voltage and frequency regulation are within the precise specification of MIL-STD 1332. Input frequency range is 45 Hz to 65 Hz with an output at 400 Hz. Weight to power ratio is 55 lb/kVA. Powertronic Systems has a unit at 15 kVA with weight to power ratio of 10 lb/kVA, somewhat lower than average at that power level. According to Powertronic Systems, this unit is not marketed at present. The same comments as before apply to California Instruments models.

In the 15 kW to 60 kW power range, none of the units stand out. The A.L.S. models meet the voltage and frequency regulation requirement for MIL-STD 1332, but the operating temperature range is 0 to 40°C . Weight to power ratios are about 15 lb/kVA for 400 Hz units and about 40 lb/kVA for 60 Hz units. The Teledyne Inet MG sets which have operating temperature ranges extending to about -40°C (MMG IA and MD4) are limited to having output frequency regulation synchronous with the input. Nova Electric has models such as FC20K3/X which allow a range of input frequencies.

In the power range greater than 60 kW, Teledyne Inet has some solid state units intended for shipboard power (AC68 thru 160). However, Teledyne states that these models are not adaptable to field use in rough terrain.

Although more flexible than other units, these units which allow a range of input frequencies are not general purpose, since multiple input voltages are not similarly available on the same units.

VI. COST INFORMATION

Only a limited amount of cost information was obtained through this survey. Where available, the cost (and cost/VA) is shown with the model designation on the data sheets. These data are displayed in the form of cost per VA versus rating in Figure 5. There is a range of approximately \$2.00/VA to \$4.25/VA in the low (<5) kVA ratings. The range tends to narrow at higher ratings and the trend, as expected, is to lower cost per VA at higher ratings (\$1.00/VA at 60 kVA). The spread is due to a number of factors including technology type, production methods, and sales, which are difficult to separate or define based on the available data.

The data are displayed in the form of cost/pound vs rating in Figure 6. At the low kVA ratings the scatter is quite large, and it is difficult to draw any conclusion. At ratings above 10 kVA the scatter is smaller, and the values are in the range of \$10/lb to \$15/lb.

Even fewer data were provided for unit cost vs quantity purchased. Those data available are plotted in Figure 7 (see, also, Table 6). Unit price has been normalized to unity at 500 units. The ordinate, then, is the relative unit cost and the abscissa is the number of units purchased. These data show that a change in the range of 9 percent to 23 percent in unit price can be expected when the purchased quantity changes from 50 units to 500 units. For two families (the upper curves), the data indicate a change of about 38 percent in unit price between 50 units and 500 units. (The smooth curves are drawn to guide the eye of the viewer; they do not represent a functional fit to the data.)

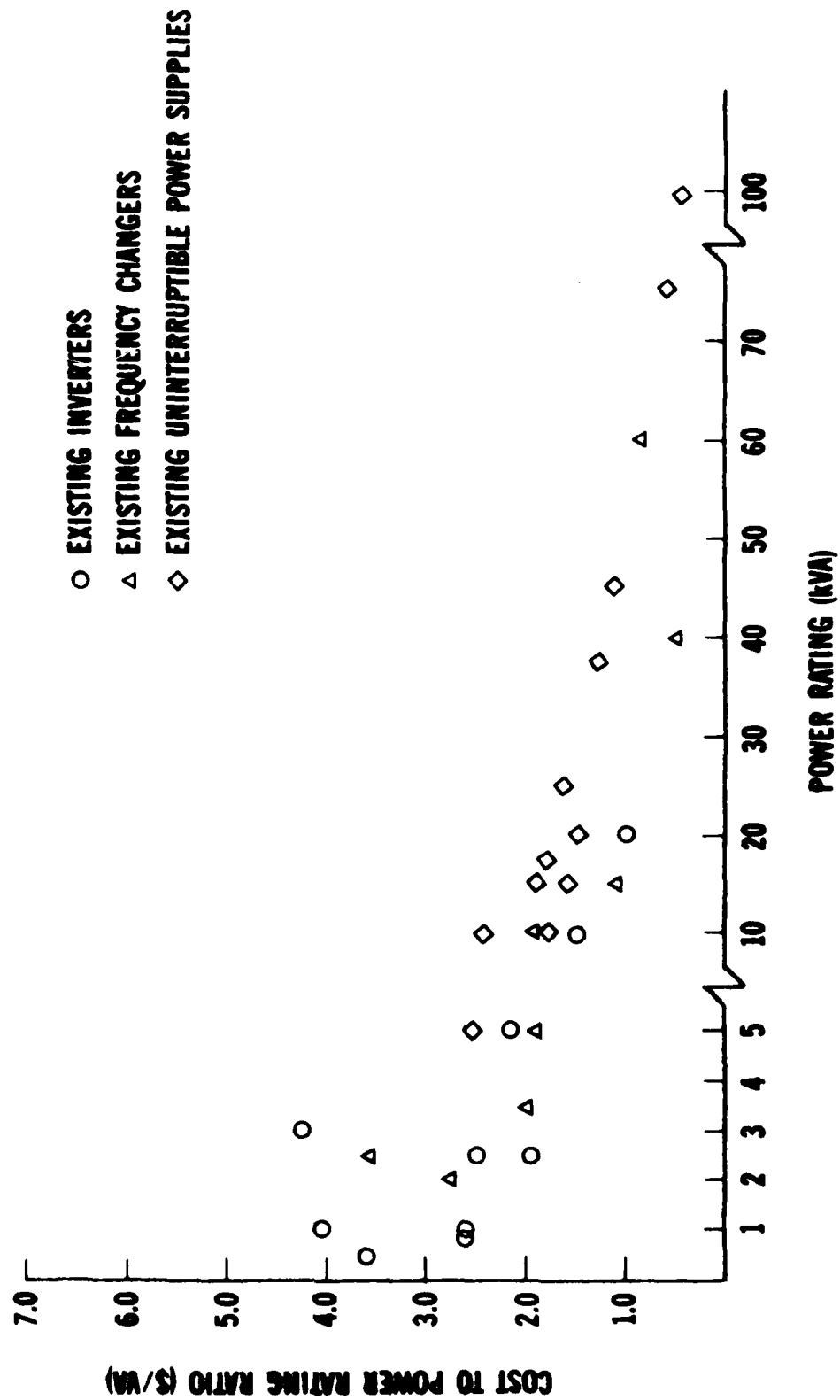


Figure 5. Cost to power rating ratio vs power rating.

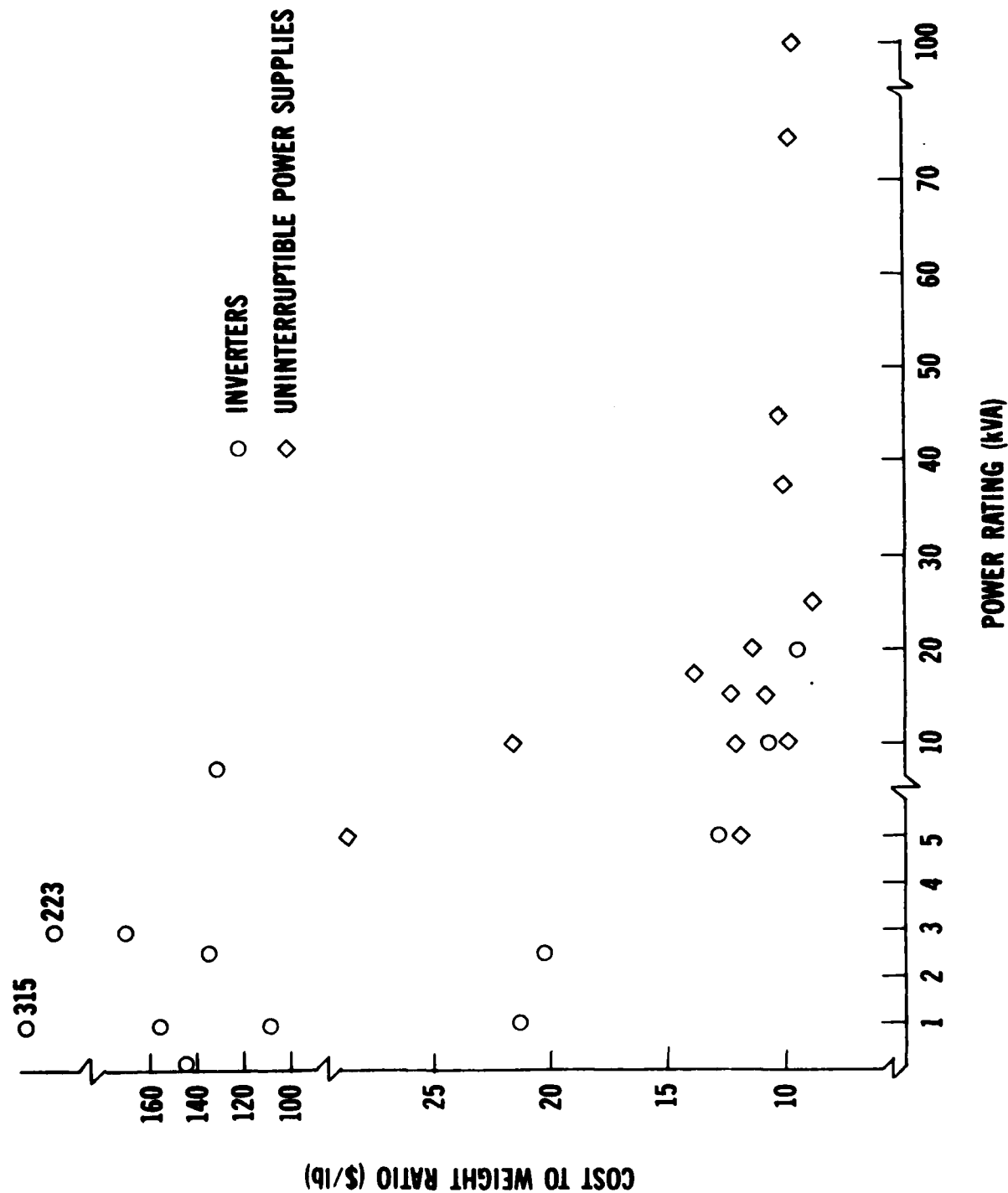


Figure 6. Cost to weight ratio vs power rating.

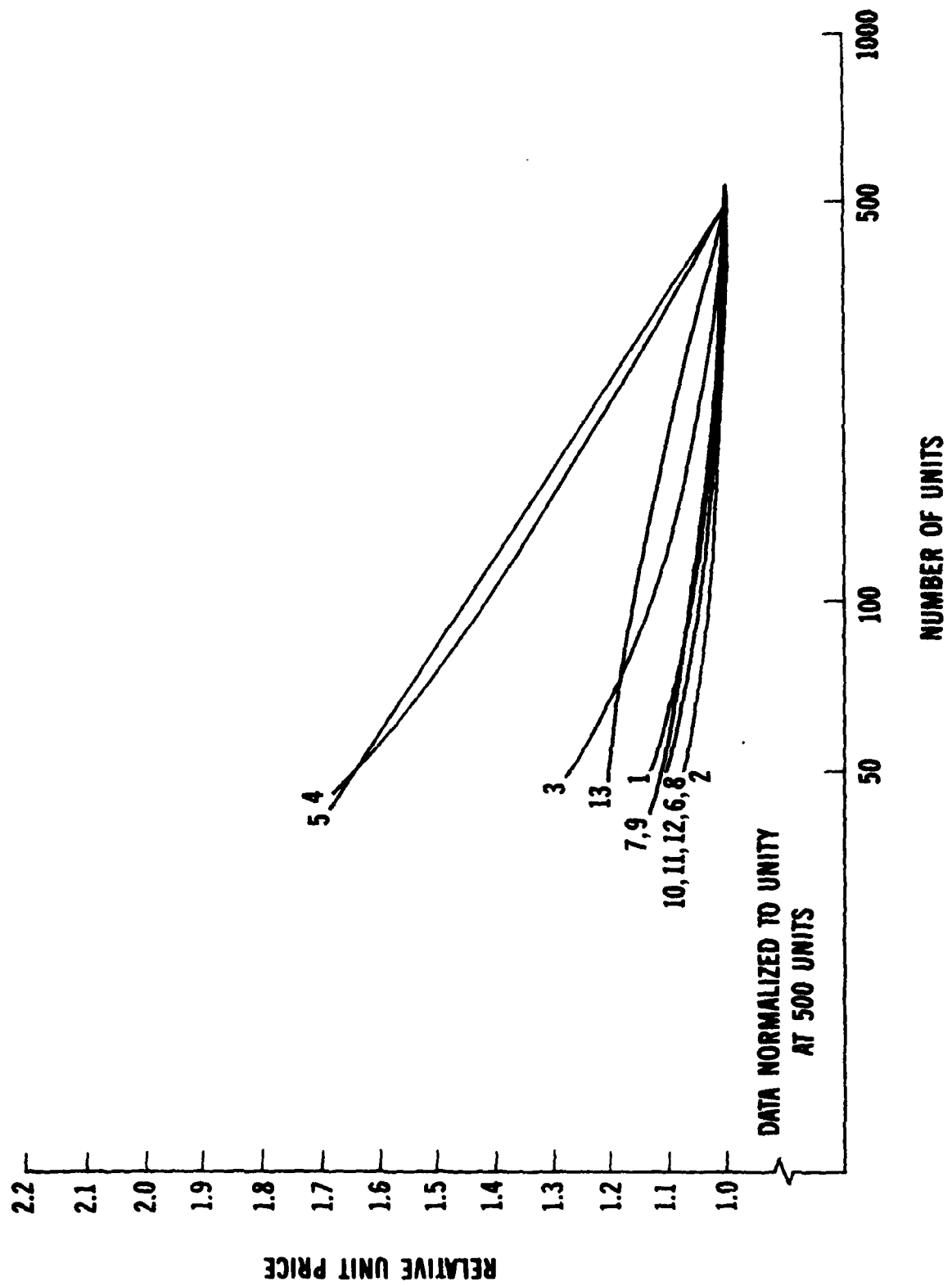


Figure 7. Relative unit price vs quantity procured.

Table 6. Key to Data in Figure 7.

Curve	Manufacturer	Model
1	UNITRON	CR-074-3
2	UNITRON	CR-154-3
3	UNITRON	GFC-40
4	UNITRON	PS-69-359
5	UNITRON	PS-62-66D
6	TELEDYNE	A/C 63
7	TELEDYNE	A/C 72
8	TELEDYNE	A/C 110
9	TELEDYNE	A/C 160
10	TELEDYNE	Series 75
11	TELEDYNE	Series 100
12	TELEDYNE	Series 125
13	WESTINGHOUSE	AVI-623

VII. CONCLUSIONS

- This survey has not located any general purpose (multi-frequency, multi-voltage, transportable, environmentally protected) power conditioners.

- Essentially all systems are single-frequency in, single-frequency out; all combinations of standard (50-Hz, 60-Hz, 400-Hz) frequencies seem to be supported.

- Most units allow only limited or no input and output voltage reconnection. Many units provide a choice of standard connections on order.

- With the exception of aircraft inverter technology, little emphasis has been given to size and weight constraints.

- Few units are designed for operation over the military temperature and altitude range.

- The categories of frequency chargers and uninterruptible power supplies are fairly well represented across the power ratings from 1-1/2 kW to 200 kW. The categories of inverters and converters are primarily represented in the lower power ranges.



ATCD-MM

APPENDIX A

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE VIRGINIA 21651

18 June 1980

SUBJECT: Letter of Agreement (LOA) for a Family of Military Electric Power Conditioners (PC)

SEE DISTRIBUTION

1. Reference AR 71-9.

2. Attached at inclosure 1 is the approved TRADOC/DARCOM Letter of Agreement for a Family of Military Electric Power Conditioners. The following information is applicable to this document:

- a. System Designation: N/A.
- b. Materiel Developer: DARCOM.
- c. Combat Developer: USATRADOC.
- d. User Representative: USATRADOC.
- e. Trainer: USATRADOC.
- f. Logistician: USALEA.
- g. CARDS Reference Number: 0611A.
- h. Operational Test Responsibility: USATRADOC.
- i. USATRADOC Proponent Activity: USAES.

3. DARCOM, in coordination with the USATRADOC proponent activity, will initiate preparation of the Outline Development Plan (ODP) IAW AR 71-9.

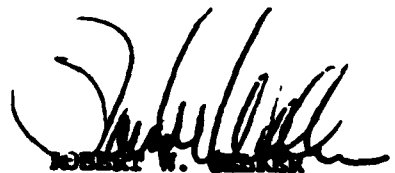
ATCD-MM

18 June 1980

SUBJECT: Letter of Agreement (LOA) for a Family of Military Electric
Power Conditioners (PC)

4. Subject requirement document is forwarded to major Army commands, other services and DoD agencies for harmonization and to all other addressees for information.

FOR THE COMMANDER:


ROBERT W. [illegible]
LTC, GS
Asst AG

1 Incl
as

DISTRIBUTION:

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(See next page)

ATCD-MM

18 June 1980

SUBJECT: Letter of Agreement (LOA) for a Family of Military Electric
Power Conditioners (PC)

DISTRIBUTION (Cont):

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USAF AIR WEA SVC (XRL)

DIRECTOR

NSA
MTMC (MTT-TRG)

LETTER OF AGREEMENT
FAMILY OF MILITARY ELECTRIC POWER CONDITIONERS (PC)

1. NEED:

a. The Army has a critical need in the 1985-1995 timeframe for a capability which will meet its increasing electrical power requirements and reduce the logistical burden associated with current approaches for conditioning the required energy. Increasing technical requirements including low acoustical and infrared (IER) signatures have been imposed on military power systems by the development of modern equipment such as computers, communications systems, target acquisition and fire control systems. Tactical power requirements for the Army require provision of such varied forms of power as: direct current (DC) and alternating current (AC) at 50/60 HERTZ (HZ), 400 HZ and 60 HZ only; single phase and three phase power; closely controlled frequency/voltage (precise power) from 28 volts DC to 460 volts AC; and uninterrupted power source (UPS) (no break power) in a range of power ratings from 1.5 kilowatts (KW) to 200 KW. Standardization efforts by the DOD Program Manager for Mobile Electric Power (PM-MEP) have reduced the types and numbers of generators for providing the required power to a minimum; however, some forms of power require costly special purpose generators. In order to provide both standard (utility) and precise power, the current system must use a utility and a precise power generator. The use of a family of power conditioners (PC) could significantly reduce, if not eliminate, the need for costly special purpose generators, thereby achieving substantial logistical savings. Power conditioners located with power consuming equipment could produce additional savings because the generator and/or distribution power ratings could be reduced through use of lower distribution frequencies or shorter distribution distances.

b. Catalog of approved requirements documents reference number:

2. OPERATIONAL CONCEPT:

a. The members of the family of electric power conditioners will be employed to condition power for tactical weapons systems in the field and for general purpose power requirements in semi-fixed locations. Employment with tactical weapons systems will require power equipment with small size, light weight and a high degree of mobility. Employment with systems in semi-fixed locations will require power equipment with increased operating life. Power conditioners can be used by all units having requirements for diverse forms of special purpose electric power in any area of the theater of operations. The family of electric power conditioners must be capable of specified performance at rated loads comparable to the special purpose generators which will be replaced. This family concept has been reviewed by the ABCA Standardization Program and other services.

b. Mission profile is attached as Annex A.

3. SYSTEM DESCRIPTION:

a. The family of electric power conditioners will consist of eight (8) solid state PC units in ratings between 1.5 KW and 200 KW to match the DOD standard family of Mobile Electric Power Sources (MEPS). Each individual power conditioner will be designed to be significantly smaller than the equivalent standard MEPS, e.g.: size - one to one hundred cubic feet, weight - 60 to 3,000 pounds, transportability - able to be transported by truck, trailer, helicopter or fixed wing aircraft as well as by, rail and marine craft. A separate operator will not be required after initial installation, except to change air filters.

b. Installation will insure that each PC unit will provide a suitable interface between an available power source and a load power requirement regardless of load or power source characteristics. The PC will be reconnectable in voltage and phase at both input and output; will provide for frequency conversion; and will be compatible with a no break or uninterrupted power source (UPS) requirement when connected to external storage batteries, fuel cells, commercial power or other auxiliary power sources to replace the prime power source. UPS is herein defined as the capability of providing steady-state power for a limited time within acceptable tolerance bands without damage to the power consuming equipment after prime power source failure occurs.

c. Reliability, availability and maintainability (RAM) is critical to the cost and operational effectiveness of the PC. Appropriate RAM requirements will be included in the PC Required Operational Capability (ROC).

d. Electronics Counter Measure/Counter-Countermeasures and Safety and Human Engineering considerations must be included in the design in accordance with applicable specifications.

e. Nuclear survivability is required and the system must be designed and constructed to survive the set of nuclear effects levels which will be stated in the outline acquisition plan and the key documents that lead up to this plan such as the Concept Formulation Package and the appropriate test plans.

f. To facilitate chemical agent decontamination, chemical agent resistant materials will be used to the maximum extent practicable in the development of this item.

g. This item will be painted with chemical agent resistant paints to facilitate chemical agent decontamination.

h. Personnel must be able to successfully perform their mission in

an NBC environment. This includes individual operations wherein personnel are clothed in their appropriate chemical/biological protective ensemble.

i. This family concept lends itself for other service or allied nation interest.

j. The system may be palletized, skid mounted or banded and will be transportable to and within the theater by highway, rail, marine and air transport. Suitable lifting and tie down devices will be provided as required.

k. All PCs must operate normally in climatic categories 1 through 6 without winterization kits.

l. All PCs must operate normally in climatic conditions 7 through 8 with winterization kits.

4. PROSPECTIVE OPERATIONAL EFFECTIVENESS AND COST:

a. The family of PCs should be able to reduce the logistics support necessary to provide electrical power in any tactical situation. This is done by reducing the need for low density special purpose generators and with the substitution of low cost tactical utility (TU) generators supplemented with PCs to meet diverse utility and precise power consuming needs required by weapons systems, maintenance shelters, or command posts. Employment of PCs in a tactical situation will reduce infrared (IR) or acoustical noise signatures over equivalently rated electrical generators, motor generator sets, rotary converters or inverters. In a peacetime situation where low acoustical noise is required, the PC can be used to convert commercial or foreign utility power sources to the proper voltage and frequency required probably at a lower cost over the use of tactical generators. These system capabilities can be achieved with no increase in crew size or logistic support requirements, probably at reduced cost relative to present systems.

b. Unit Flyaway Cost. Broad based estimates of unit flyaway cost expressed in constant FY78 dollars is \$1592 for the 1.5 KW PC, \$2684 for the 3 KW PC, \$3264 for the 5 KW PC, \$14,338 for the 10/15 KW PC, \$16,644 for the 30 KW PC, \$23,982 for the 60 KW PC, \$38107 for the 100 KW PC and \$60,514 for the 200 KW PC.

c. Manpower savings should result since there will be no increase in operator requirements and a potential decrease in annual maintenance man hours. Forecasted reduction in operator/maintenance man hours is envisioned by standardization of generators and an anticipated reduction in the inventory of special purpose generators.

5. SYSTEM DEVELOPMENT:

a. Operational Employment Plan: Commander, HQ TRADOC with input from HQ DARCOM will conduct the necessary studies, war games, test and evaluations to define the operational concepts. A system unique event that must be addressed by the combat developer and materiel developer is if the PC can provide military units with the conditioned power in required amounts and characteristics needed for mission accomplishment.

b. Technical Development Plan: The following system unique events will be addressed by the materiel developer:

(1) A study of frame sizes to determine whether the number of proposed ratings of the family of power conditioners can be changed or reduced to meet user needs.

(2) Establish whether the order of developments of individual ratings is optimal for maximum transfer of technology.

(3) The Combat and Materiel Developers will jointly develop RAM requirements for inclusion in the subsequent ROC or LR. Together they will develop a RAM Rational Annex that justifies and supports the quantitative RAM requirements. As a minimum, the RAM Rational Annex will contain the operational mode summary/mission profile, failure definition/scoring criteria, baseline analysis historical data, and definitions of RAM terms that are unique to this materiel.

(4) RAM will be a critical test issue for DTI and OTI.

c. Logistics Support Plan: The Combat and Materiel Developers will jointly conduct appropriate analysis and planning effort to assure that:

(1) System design is such that Logistic Support, manpower and skill requirements are not increased beyond the capabilities of presently assigned MOS personnel.

(2) RAM requirements are sufficiently high to assure that the Logistic Support burden will not be increased with the addition of the item to using unit TOEs.

d. Training Support Concept:

(1) The materiel developer, in coordination with the TRADOC proponent, will develop a detailed training subsystem capable of providing a complete transfer of knowledge from the developer to the system user and maintainer. This training subsystem will be based upon a precisely defined set of performance requirements obtained through analysis or collection of Logistic Support Analysis (LSA) data generated IAW DARCOM Pam 750-16 or MIL-M3035, as appropriate. Based on the results of this analysis, DARCOM/TRADOC will jointly agree upon a detailed task list covering all operator and maintenance difficult to train tasks for the system. The identification of and agreement on these tasks will be a formal, identifiable milestone in the validation phase of development. Tasks so identified will be incorporated into a signed agreement and into the system outline acquisition plan.

(2) TRADOC will describe the user population to the materiel developer and assist the materiel developer in identifying any unusual training requirements inherent in the intended user population.

(3) The DARCOM materiel developer will develop an outline of each TM to be produced, and preliminary draft documentation and storyboard training materials for tasks selected for training IAW approved Skill Performance Aids (SPAS) specifications. Deliverable products for DT/OT I will be determined between DARCOM and TRADOC on a case-by-case basis. The draft documentation and training produced as a result of this determination will be used to train operator/crew and maintenance personnel representative of the user population for OT I.

(4) The need for training requirements and materials, such as class room trainers or collective trainers, which are not identified as a result of the SPAS work effort, will be investigated. The necessary TRADOC/DARCOM responsibilities and resources to develop these training materials will be established and requirements will be included in the ROC or separate requirement documents, as appropriate.

(5) TRADOC will develop an outline individual and collective training plan (OICTP), outlining the initial system training concept and strategy and as much of the individual and collective unit and institutional training requirements as known.

(6) The capability of the player personnel, trained with the draft documentation and storyboard training materials, to perform the task selected for training to the required standards in the field phase of OT I will be made a critical test issue.

(7) The training support plan will be available for evaluation at OT I.

e. Personnel Support Plan. There are no personnel constraints related to mission area or force level. Introduction of this system will reduce the overall number of special purpose generators which will, in turn, decrease the annual maintenance man hours. This may result in some reduction of manpower requirements at the general support and depot support maintenance levels.

SCHEDULE & MILESTONES.

EVENT	FAMILY	SIZE (KILOWATTS (KW))									
		1.5 KM	3	5	10/15	30	60	100	200		
a. LOA Approved	4QFY80	-	-	-	-	-	-	-	-	-	-
b. Outline Acquisition Plan (OAP)											
(1) Initiated	4QFY80	-	-	-	-	-	-	-	-	-	-
(2) Completed	4QFY81	-	-	-	-	-	-	-	-	-	-
c. Special IPR for OAP Approval	1QFY81	-	-	-	-	-	-	-	-	-	-
d. Advanced Dev											
(1) Initiated	4QFY79	1QFY81	1QFY81	1QFY83	1QFY81	1QFY81	1QFY83	1QFY84	1QFY84	1QFY84	1QFY84
(2) Completed	1QFY86	4QFY82	4QFY82	4QFY84	4QFY82	4QFY83	3QFY85	2QFY86	2QFY86	2QFY86	2QFY86
e. Concept Formulation Package											
(1) Initiated	1QFY81	1QFY81	1QFY81	1QFY83	4QFY80	1QFY81	1QFY83	1QFY84	1QFY84	1QFY84	1QFY84
(2) Completed	3QFY85	1QFY82	1QFY82	4QFY84	3QFY81	1QFY83	4QFY84	3QFY85	3QFY85	3QFY85	3QFY85
f. DT I/OT I											
(1) Initiated	3QFY80	3QFY82	1QFY84	1QFY84	2QFY82	1QFY83	1QFY85	3QFY85	3QFY85	4QFY85	4QFY85
(2) Completed	1QFY86	4QFY82	3QFY84	3QFY84	4QFY82	3QFY83	3QFY85	1QFY86	1QFY86	2QFY86	2QFY86
g. COEA											
(1) Initiated	4QFY80	4QFY81	3QFY83	3QFY83	2QFY81	4QFY82	3QFY84	2QFY85	3QFY85	3QFY85	3QFY85
(2) Completed	1QFY86	2QFY82	1QFY84	1QFY84	4QFY81	1QFY83	1QFY85	4QFY85	1QFY86	1QFY86	1QFY86
h. Acquisition Plan											
(1) Initiated	4QFY80	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81
(2) Completed	2QFY86	4QFY82	3QFY82	4QFY84	1QFY82	4QFY83	4QFY85	2QFY86	2QFY86	2QFY86	2QFY86
i. VAL IPR	1QFY81-2QFY86	4QFY82	3QFY82	4QFY84	4QFY82	4QFY83	4QFY85	3QFY86	3QFY86	3QFY86	3QFY86

7. **FUNDING:** (\$000) Breakouts of funding by fiscal year and priority for each proposed family member in constant and then year dollars are attached as Annexes C & D respectively. The top three priority members can be accommodated with approved funding guidance.

a. **ADVANCED DEVELOPMENT (6.3)**

Range:	<u>LOW</u>	<u>HIGH</u>
Constant (FY 80)	\$ 2964	\$ 6754
Inflated (Then Year)	\$ 3947	\$ 8994

Most Likely Funding Profile:	<u>FY81</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u>	<u>FY85</u>	<u>FY86</u>	<u>TOTAL</u>
Approved Program (I)	505	633	323	--	--	--	1461
Constant (FY 80)	464	538	641	1250	1345	621	4859
Inflated (Then Year)	505	633	811	1690	1930	946	6515

Quantity of Prototypes: 1 preprototype plus 2 prototypes of each rating.

Sunk Costs (Excluded from Paragraph a): R&D (Actual) \$410 R&D (Constant) \$481

b. **ENGINEERING DEVELOPMENT (6.4)**

Range:	<u>LOW</u>	<u>HIGH</u>
Constant (FY 80)	\$ 14088	\$ 28458
Inflated (Then Year)	\$ 22642	\$ 45738

Most Likely Funding Profile:	<u>FY83</u>	<u>FY84</u>	<u>FY85</u>	<u>FY86</u>	<u>FY87</u>	<u>FY88-90</u>	<u>TOTAL</u>
Approved Program (I)	891	2686	2795	1895	383	--	8650
Constant (FY 80)	704	1987	2771	3445	2011	7966	18884
Inflated (Then Year)	891	2686	3973	5240	3247	14314	30351

Quantity of Prototypes: 4 prototypes of each rating.

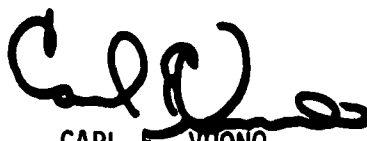
c. **UNIT FLYAWAY COST (CONSTANT FY 80 DOLLARS)**

<u>PRI</u>	<u>ITEM</u>	<u>UNIT COST (\$)</u>	<u>QUANTITY</u>	<u>LEARNING SLOPE (%)</u>
3	1.5	1,592	15000	86
4	3	2,684	10000	87
5	5	3,264	15000	88
1	10/15	14,338	5000	90
2	30	16,644	2500	91
6	60	23,982	600	92
7	100	38,107	500	94
8	200	60,514	100	96

NOTES: Source Document for cost is Abbreviated BCE, dated March 1979.
Inflation has been incorporated in accordance with DARCOM Letter, DRCCP-ER, provided on 28 January 1980.

NERADCOM COST ANALYSIS DIVISION
CECDC Control # 3702 Validation Level: II
7 Validated: 16 APR 80 Expires: 16 APR 81
Analyst: K. E. ER Phone # 44672

FOR THE COMMANDER:



CARL E. VUONO
Brigadier General, GS
Deputy Chief of Staff
for Combat Developments

2 Incl

1. Mission Profile
2. Coordination Annex



STAN R. SHERIDAN
Major General, USA
Director of Development
and Engineering

ANNEX A
MISSION PROFILE

1. MISSION PROFILE:

a. WEAPONS POSING THREAT TO SYSTEM:

	<u>BDE</u>	<u>DIV</u>	<u>CORPS</u>	<u>REAR</u>
Small Arms	X			
Arty	X	X		
TAC AIR	X	X	X	X
Missile/Rocket	X	X	X	X

b. MISSION: Provide military units with conditioned electric power in required amounts and characteristics.

c. WEATHER EXTREMES: Climate categories 1-6. If supported equipment must operate in categories 7 or 8, protective shelter or kits may be provided.

d. TASKS:

(1) The function of electric power conditioners is to convert power for any period ranging from short intermittent periods to periods up to 24 hours per day for extended periods. Because solid state technology will be used in the power conditioners, and they will be electrically connected to a power source, tasking elements are expected to be based on that required for the power source. In this example, tasking is that required for tactical generators.

(2) <u>TASKS ELEMENTS</u>	<u>TIME</u>	<u>% OF TIME</u>
(a) Set up generator	15 min	1%
(b) Start generator	15 min	1%
(c) Operate at demand levels	21.5 hrs	90%
Full load	5 hrs	21%
75% load	6 hrs	25%
50% load	5 hrs	21%
25% load	4.5 hrs	19%
on line-0 load	1 hr	4%
(d) Shut down generator	15 min	1%
(e) Service time	30 min	2%
(f) Prepare for movement	15 min	1%
(g) Move to new site	1 hr	4%
MISSION TIME	24 hrs	

2. MOBILITY: System can be transported on vehicle types presently organic to units with no unacceptable degradation of the present mobility of those units.

3. OPERATING SUMMARY:

Conditioning Power - 89.5%

Not Conditioning Power - 10.5%

ANNEX B

COORDINATION ANNEX

Family of Military Electric Power Conditioners (PC)

Coordination with the following agencies has produced the following comments:

<u>AGENCY</u>	<u>CONCUR</u>	<u>COMMENTS RECEIVED</u>	<u>ACCEPTED</u>	<u>REJECTED</u>
HQDA (DAMO-RQ)	X	0	-	-
USAREUR & Seventh Army	X	0	-	-
USA Pacific Spt Gp	X	0	-	-
Eighth US Army	X	0	-	-
FORSCOM	X	0	-	-
DARCOM	X	0	-	-
Chief of Naval Operations	X	0	-	-
Chief of Naval Materiel	X	0	-	-
Comdt, USMC	X	0	-	-
Marine Corps Dev & Educ Comd	X	0	-	-
HQ, USAF	X	0	-	-
CDR, TAC	X	0	-	-
Health Sciences Command	X	0	-	-
British Army Staff	-	0	-	-
Canadian Forces Attache (Land)	-	0	-	-
Australian Army Representative	X	0	-	-

ANNEX C

COST PROFILE (FY80 CONSTANT YEAR \$)

<u>CAT</u>	<u>PRI</u>	<u>RATING</u>	<u>FY81</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u>	<u>FY85</u>	<u>FY86</u>	<u>FY87</u>	<u>FY88</u>	<u>FY89</u>	<u>FY90</u>
6.3	1	10/15	222	224								
	2	30	142	175	255							
	3	1.5	<u>100</u>	<u>139</u>	<u>255</u>							
TOTAL 6.3	APPROVED		464	538								
	4	3			141	283						
	5	5			151	303						
	6	60			94	403	223					
	7	100				110	473	262				
	8	200			<u>386</u>	<u>151</u>	<u>649</u>	<u>359</u>				
TOTAL 6.3	UNFUNDED					1250	1345	621				
6.4	1	10/15			317	748	974	227				
	2	30				332	782	1019	237			
	3	1.5			<u>387</u>	<u>907</u>	<u>193</u>	<u>237</u>				
TOTAL 6.4	APPROVED				704	1987	1949	1246	237			
	4	3					402	944	201			
	5	5					420	986	210			
	6	60						269	672	1236	511	
	7	100							317	792	1458	602
	8	200							<u>374</u>	<u>935</u>	<u>1721</u>	711
TOTAL 6.4	UNFUNDED						822	2199	1774	2963	3690	1313

MERADCOM COST ANALYSIS DIVISION

CECDC Control # 3702 Validation Level: II
 Validated: 16 APR 80 Expires: 16 APR 81
 Analyst: KENNER Phone # 44672
 Supervisor: Robert P. Hunt Remarks: _____

ANNEX D

COST PROFILE (THEN YEAR \$)

CAT	PRI	RATING	FY81	FY82	FY83	FY84	FY85	FY86	FY87	FY88	FY89	FY90
6.3	1	10/15	242	263								
	2	30	154	206	323							
	3	1.5	109	164								
TOTAL 6.3	APPROVED		505	633	323							
	4	3			178	383						
	5	5			191	410						
	6	60			119	545	320					
	7	100				149	678	399				
	8	200				204	931	547				
TOTAL 6.3	UNFUNDED				488	1691	1929	946				
6.4	1	10/15			401	1011	1397	345				
	2	30				449	1121	1550	383			
	3	1.5			490	1226	277					
TOTAL 6.4	APPROVED				891	2686	2795	1895	383			
	4	3					576	1436	324			
	5	5					602	1500	339			
	6	60						409	1085	2117	929	
	7	100							512	1357	2650	1161
	8	200							604	1601	3128	1371
TOTAL 6.4	UNFUNDED						1178	3345	2864	5075	6707	2532

MERADCOM COST ANALYSIS DIVISION

CECDC Control # 3192 Validation Level: II
 Validated: 16 APR 10 Expires: 16 APR 11
 Analyst: KEELER Phone # 44612
 Supervisor: Robert O. Wood Remarks: _____

POWER CONDITIONING EQUIPMENT QUESTIONNAIRE

1. **Manufacturer's Name:**

2. Description of Equipment:

[illegible]

3. Description of Technology Used (non-propriety)

[illegible]

3.b. What are the major components used?

4a. Electrical Output Specifications

Model Designation	Regulation %		Total Harmonic Distortion		DC Content Output (mW)	Maximum Phase Displacement (degrees)	Variation with temperature expansion of 60°F in 8 hrs.		Modulation %	
	voltage frequency		Output Voltage	Input Current			Voltage Frequency	Voltage Frequency	Voltage Frequency	Voltage Frequency

4b. To what extent is a transient disturbance (e.g. voltage spike) on the input line attenuated or prevented from appearing on the output?

5. Load and Input Limitations

Model Designation	Output Power Factor Acceptable Range	DC Output Impedance	OVERLOAD		SHORT CIRCUIT		INPUT LINE	
			Continuous	Current & Time at 90% Voltage	Current	Time	Permissible Voltage Distortion %	Permissible frequency deviation

6.a. Ambient Conditions

Model Description	Ambient limits			Outdoor		Method of Cooling
	Temperature	Humidity	Elevation	Enclosure	Cooling	

8.a. Controls and Protective Features

Model Description	Detachable Control Panel for Remote Operation	Paralleling Capability	PROTECTION METHODS			
			Input/Output Over/Under Voltage	Input Over/Under Frequency	Over-temperature	Output Overcurrents & Fault Currents

8.b. To what electrical safety standards (e.g. NEMA, UL) does the equipment conform?

8.c. What meters and indicators are normally available?

9. Production

Model Designation	ESTIMATED UNIT COST			Production Rate (units per month)
	Quantity 50 (\$ each)	Quantity 100 (\$ each)	Quantity 500 (\$ each)	

APPENDIX C



DEPARTMENT OF THE ARMY
US ARMY MOBILITY EQUIPMENT RESEARCH & DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA 22060

January 18, 1983

DRDME-PEB

Gentlemen:

A survey of available commercial power conditioning equipment (e.g., inverters, converters or frequency changers) is being conducted to assess currently available technology in this field. The information will be used in planning an approved program to develop or adapt power conditioning equipment for U.S. Army field use. The survey is not limited to solid state equipment; all types of equipment, including rotating machinery (e.g., motor-generator sets) are to be considered.

You are invited to participate in this study by completing the enclosed questionnaire for each model of power conditioning equipment which you manufacture. Additional commercial literature would also be useful.

In order to meet our survey schedule, your response by 15 February 1983 will be appreciated.

The information is requested for planning purposes. The Government does not intend to award a contract on the basis of this request or otherwise pay for information solicited.

For additional information, please contact Dr. W. David Lee (703) 664-5724.

Sincerely,


Herb Rothschild
Contracting Officer

Enclosure

APPENDIX D



DEPARTMENT OF THE ARMY
US ARMY MOBILITY EQUIPMENT RESEARCH & DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA 22060

ORDME-PM

8 December 1982

SUBJECT: Synopsis of Proposed Procurements

US Department of Commerce
Commerce Business Daily
P.O. Box 5999
Chicago, IL 60680

No. 27

US Army Mobility Equipment Research and Development Command, Procurement and
Production Directorate, Fort Belvoir, VA 22060

A -- INFORMATION FOR USE IN PLANNING A DEVELOPMENT PROGRAM FOR MILITARY
POWER CONDITIONING EQUIPMENT. Sources sought for manufacturers of power
conditioning equipment of both solid state and rotating design (e.g., inverters,
converters and frequency changers) to provide information via a questionnaire.
The questionnaire requests data on cost, performance and availability of power
conditioning equipment now on the market. Information will be used in planning
a program to develop or adapt power conditioning equipment for Army field use.
THE GOVERNMENT DOES NOT INTEND TO AWARD A CONTRACT ON THE BASIS OF THIS REQUEST
OR OTHERWISE PAY FOR THE INFORMATION SOLICITED. Interested firms are invited to
submit information or data no later than 10 January 1983. U.S. Army MERADCOM,
DRDME-PEA, Fort Belvoir, VA 22060. B. BALLINGER/(703) 664-5140.

Nancy S. Vannice
NANCY S. VANNICE
Chief, Procurement Management Division
Procurement and Production Directorate

APPENDIX E

Abex-Jetway
3100 South Pennsylvania Ave.
Ogden, UT 84409

d.,e.

Aerospace Avionics Incorporated
Airport International Plaza
Bohemia, NY 11716

c.,e.

Airsupply Company
2690 Cumberland Parkway, Suite 460
Atlanta, GA 30339

c.

ALS Corporation
1400 N. Baxter Street
Anaheim, CA 92806

c.,e.

Alturdyne
8050 Armour Street
San Diego, CA 92111

a.,c.,d.,e.,h.

Arthur Wagner Company
1446 West Randolph Street
Chicago, IL 60607

c.,d.,e.

Atlas Energy Systems
9457 Rush Street
El Monte, CA 91733

c.

Avco Everett Research Laboratory, Inc.
2385 Revere Beach Parkway
Everett, Massachusetts 02149

c.

Avionic Instruments Incorporated
943 East Hazelwood Avenue
Rahway, NJ 07065

c.,d.,e.

Belyea Company, Incorporated 38 Howell Street Jersey City, NJ 07306	c.,e.
Bendix Corporation Electric Power Division Eatontown, NJ 07724	c.,e.
Bogue Electric Manufacturing Company 102-T Pennsylvania Avenue Paterson, NJ 07509	c.,e.
California Instruments 5150-T Convoy St. San Diego, CA 92111	e.
OML Macarr, Incorporated Sub. of Marine Electric R.P.D., Inc. 165 National Road Edison, NJ 08817	c.,e.
Creative Technology, Incorporated 14415 N. Scottsdale Road Scottsdale, AZ 85260	c.
CYBEREX 7171 Industrial Park Boulevard Mentor, OH 44060	a.,c.,e.
Electronic Marketing Assoc, Inc. (Representing Elgar, Dymarc, Oneac) 11716 Parklawn Drive Rockville, MD 20852	a.,c.,e.
Elgar Corporation 8225 Mercury Court San Diego, CA 92111	a.,c.
EMP Electronics, Inc. 1231 W. 23rd St Tempe, AZ 85282	e.

Essex Electro Engineers, Incorporated 729 Thomas Drive Bensenville, IL 60106	a.,c.
Exide Electronics 3301 Spring Forest Road Raleigh, N.C. 27604	e.
Fermont Division Dynamics Corporation of America 141 North Avenue Bridgeport, CT 06606	c.,g.
Flite - Tronics Co., Inc. 2525 N. Naomi Street Burbank, CA 91504	e.
Franklin Electric Programmed Power Division 995 Benicia Avenue Sunnyvale, CA 90509	c.,e.
Garrett Airesearch Manufacturing Co. 2525 West 190th Street Torrance, CA 90509	c.
General Electric Co. Research & Development Center P.O. Box 43 Schenectady, NY 12301	c.
GEORATOR Attn: Mr. Jere Smith 9617 Center Street Manassas, VA 22110	c.,d.,e.
Good-All Electric, Company Attn: Michael Hurd, Sales Mgr. Government Products 3725 Canal Drive Ft. Collins, CO 80524	a.,c.,d.,e.

Gould Deltec
Gould, Inc., Power Conversion Division
2727 Kurtz Street
San Diego, CA 92110

c.,e.

Helionetics, Inc.
Delta Electronic Control Corp. Div
17312 Eastman Street
Irvine, CA 92714

a.,c.,e.

Hughes Aircraft Co.
Electron Dynamics DW
3100 West Lomita Blvd.
Torrance, CA 90509

a.,c.

Industrial Systems, Incorporated
1121 Fresno
San Antonio, TX 78201

a.,c.

Introl Corporation
2314 East 8th Street
Los Angeles, CA 90021

a.,c.

Jet Electronics and Technology Inc.
5353 52nd St., S.E.
Grand Rapids, MI 49508

e.

KATO Engineering
Subsidiary of Reliance Electric
1467 First Avenue, North
Mankato, MN 56001

c.

RGS Electronics
2029 North Lincoln Ave.
Pasadena, CA 91103

e.

Kurtz & Root Company
P.O. Box 1119
Appleton, WI 54912

e.

Leland Electrosystems Inc. c.
P.O. Box 128
Vandalia, OH 45377

Lockheed Missiles & Space Co., Inc. c.
Ocean Systems, San Diego
3929 Calle Fortunada
San Diego, CA 92123

Louis Allis Company c.
Dept. TR
427 East Stewart Street
Milwaukee, WI 53201

Martin Marietta Aerospace c.
P.O. Box 5837 MP508
ATTN: E. Warren Spahr
Tech Dir, R&D Elec Lab
Orlando, FL 32855

Morse Industrial Products c.
Borg-Warner Corporation
6291 Barfield Road, Suite 102
Atlanta, GA 30328

NOVA Electric Manufacturing Co. c.
263 Hillside Avenue
Nutley, NJ 07110

Power Energy Industries c.,e.
17115 Kingsview Avenue
Carson, CA 90746

Power Engineering c.
6879 Fashion Hills Blvd.
San Diego, CA 92111

Powertronic Systems, Incorporated c.,d.
P.O. Box 29109
New Orleans, LA 70149

Raytheon Company
Hartwell Road
Bedford, MA 01730

c.

Safety Electrical Equipment Corporation
26 Barnes Park Road, North
P.O. Box 798
Wallingford, CT 06492

c.

Simmonds Precision, Engine Systems
Norwich-Oxford Road
P.O. Box 310
Norwich, NY 13815

a.,c.

Tech Systems Corporation
Precise Power Systems Division
402 Watertown Road
Thomaston, CT 06787

c.

Teledyne Inet
2750 W. Lomita Blvd.
Torrance, CA 90509

a.,c.,d.,e.

Topaz Electronics Division
6291 Bartfield Road, Suite 102
Atlanta, GA 30328

a.,e.,e.

United Technologies
Power Systems Division
P.O. Box 109
South Windsor, CT 06074

c.

Unitron Corporation
Attn: Mr. Chuck Sites
P.O. Box 2159
Garland, TX 75041

c.,d.,e.

VARO, Incorporated
Power Systems Division
2201 W. Walnut Street
P.O. Box 401267
Garland, TX 75040

a.,c.,e.

WER Industrial
3036 Alt. Boulevard
Dept. A
Grand Island, NY 14072

c.

Westinghouse Electric Corporation
P.O. Box 989
Lima, OH 45802

c.,d.,e.

William I. Horlick CO., Inc.
266 Summer Street
South Boston, MA 02210

c.

AEG Telefunken
Aussenstelle Koblenz 1
Rheinstr. 17
Postfach 107
D 5400 Koblenz 2
Attn: Mr. Schneider
Federal Republic of Germany

b.,c.

Allanson Manufacturing Company Limited
33 Cranfield Road
Toronto, Ontario, Canada
M4B 3H2

b.,c.

Brown Boveri Canada Inc.
Walter Flex Strasse 1
D 5300 Bonn 1
Attn: Mr. Dommermuth
Federal Republic of Germany

b.,c.

CEAG Licht and Stromversorgungstechnik GmbH
(for Brown, Boveri, Bonn)
Abt. MV2
4770 Soest - Postfach 78

d.

CTS of Canada Limited
80 Thomas Street
Streetsville, Ontario, Canada
L5M 1Y9

b.,c.,d.,e.

Cullen Detroit Diesel Allison Ltd
P.O. Box 82100
Burnaby, B.C., Canada V5C 5p6

h.

Delta Enterprises (Sarnia) Limited
P.O. Box 2049
177 Samuel Street
Sarnia, Ontario, Canada

b.,c.

Exide Canada Inc.
5200 Dixie Road, Unit 20
Mississauga, Ontario, Canada
L4W 1W2

b.,c.

Firma Benning
Muensterstr. 135
D 4290 Bucholt
Attn: Mr. Borkers
Federal Republic of Germany

b.,c.

Firma Industrie Automation
Am Unter Gruenen 6
D 7801 March - Buchheim
Attn: Mr. Kartscher
Federal Republic of Germany

b.,c.

Leroy Somer Canada Limited
337 rue Deslauriers
Montreal, Quebec, Canada
H4N 1W2

b.,c.

Mawdsley's LTD
Dursley
Gloucestershire GL 115AE England

d.,e.

Nife-Powertronics Corporation
125 Nantucket Blvd.
Scarborough, Ontario, Canada
M1P 2N8

b.,c.

Siemens AG
Abt. E 481
Postfach 3240
D 5820 Erlangen 2
Attn: Mr. Baum
Federal Republic of Germany

b.,c.

Staticon Limited
390 Tapscott Road, Unit 6
Scarborough, Ontario, Canada
M1B 2Y9

b.,c.

Telecom Power Corporation
2779 Lake City Way
Burnaby, British Columbia, Canada
V5A 2Z8

b.,c.

Willetts Mfg. Company, a division of
A.C. Duce Electric Ltd.
P.O. Box 340
937 Eva Street
Estevan, Saskatchewan, Canada
S4A 2A4

b.,c.

Key to Appendix E

- a. Responded to CBD Solicitation
- b. Source obtained from Embassy or Liason office
- c. Letter of request, questionnaire sent to company
- d. Provided data via questionnaire
- e. Provided data sheets
- f. Returned to sender
- g. Responded, not presently in this field
- h. Furnished data on engine-generator sets only

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